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Office of Research and Development

Industrial Environmental Research Laboratory
Research Triangle Park, North Carolina 27711

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MULTIMEDIA ENVIRONMENTAL GOALS FOR ENVIRONMENTAL ASSESSMENT
Volume II. MEG Charts and Background Information

Interagency
Energy-Environment
Research and Development
Program Report

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This report has been assigned to the INTERAGENCY ENERGY-ENVIRONMENT RESEARCH AND DEVELOPMENT series. Reports in this series result from the effort funded under the 17-agency Federal Energy/Environment Research and Development Program. These studies relate to EPA's mission to protect the public health and welfare from adverse effects of pollutants associated with energy systems. The goal of the Program is to assure the rapid development of domestic energy supplies in an environmentally--compatible manner by providing the necessary environmental data and control technology. Investigations include analyses of the transport of energy-related pollutants and their health and ecological effects; assessments of, and development of, control technologies for energy systems; and integrated assessments of a wide range of energy-related environmental issues.

REVIEW NOTICE

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MULTIMEDIA ENVIRONMENTAL GOALS FOR ENVIRONMENTAL ASSESSMENT
Volume II. MEG Charts and Background Information

by

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APPENDIX E

MEG Charts and Background Information Summaries for 216 Chemical Substances

INTRODUCTION

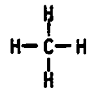
Consistent with the methodology developed for establishing Multimedia Environmental Goals in Sections 3 - 7, 216 chemical substances are addressed in this report. MEG charts along with the Background Information Summaries for these substances are presented in this appendix which includes 162 organic compounds and 54 inorganic substances. The charts and summaries (presented on facing pages) are arranged in the order that they appear on the MEG's master list. Although all substances on the master list have not yet been addressed, at least one entry from each major organic category and from each inorganic subgroup has been included in the MEG charts.

CATEGORY: 1A

WLN: 1H

METHANE: CH_4 (marsh gas, methyl hydride).
A colorless, odorless, flammable, tasteless gas.

STRUCTURE:



PROPERTIES:

Molecular wt: 16.04; mp: -182.48; bp: -164^{760};
d: 0.466^{164} to 0.5547; soluble; vap. d: 0.6;
vap. press.: 1 atm at -161.5°.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Rural background concentration in air is reported as 1.2 to 2.0 ppm (ref. 1). This is equivalent to 780 to 1,000 $\mu g/m^3$. Methane does not participate appreciably in photooxidation reactions.

TOXIC PROPERTIES, HEALTH EFFECTS:

No significant physiologic effects are reported for exposed workers.
Aquatic toxicity: TLm 96: over 1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Classified as a simple asphyxiant by ACGIH.
TLV_{SA} = 5,000 ppm or 3,270 mg/m^3.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.27×10^6 $\mu g/m^3$ (5,000 ppm)
Water, Health: $15 \times 3.27 \times 10^6 = 4.9 \times 10^7$ $\mu g/\ell$
Land, Health:

Air, Ecology:
Water, Ecology: $100 \times >1,000 = >1.0 \times 10^5$ $\mu g/\ell$
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 3,270/420 = 7,800$ $\mu g/m^3$
$EPC_{AH1a} = 5,000/420 = 11.9$ ppm
$EPC_{WH1} = 15 \times 7,800 = 1.17 \times 10^5$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 3,270 = 4.5 \times 10^4$ $\mu g/\ell$

$EPC_{WE1} = 50 \times >1,000 = >50,000$ $\mu g/\ell$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			3.27E6 (5,000)		7,800 (11.9)		
Water, μg/l (ppm Wt)			4.9E7	>1.0E5	45,000	>50,000	
Land, μg/g (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			7,800 (11.9)		
Water, μg/l (ppm Wt)			45,000	>50,000	
Land, μg/g (ppm Wt)					

CATEGORY: 1A

WLN:

ETHANE: C_2H_6 (bimethyl, methylmethane, dimethyl, ethyl hydride). A colorless, flammable, odorless gas.

STRUCTURE:

H_3C-CH_3

PROPERTIES:

Molecular wt: 30; mp: -172; bp: -88.6; d: 0.572_4^{-108}; vap. d: 1.04; slightly soluble; vap. press.: 760 mm at -88.6°.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Rural concentration in air is reported as 3.6 ppbc (ref. 1). This is equivalent to 2.2 $\mu g/m^3$. Ethane participates to a very limited extent in photooxidation reactions (ref. 3).

TOXIC PROPERTIES, HEALTH EFFECTS:

No significant physiologic effects are reported for exposed workers.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Classified by ACGIH as a simple asphyxiant.

TLV_{SA} = 5,000 ppm or 6,122 mg/m^3.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 6.12×10^6 $\mu g/m^3$ (5,000 ppm)
Water, Health: $15 \times 6.12 \times 10^6 = 9.2 \times 10^7$ $\mu g/\ell$
Land, Health:

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 6{,}122/420 = 14{,}600$ $\mu g/m^3$
$EPC_{AH1a} = 5{,}000/420 = 11.9$ ppm
$EPC_{WH1} = 15 \times 14{,}600 = 2.2 \times 10^5$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 6{,}122 = 8.4 \times 10^4$ $\mu g/\ell$

MULTIMEDIA ENVIRONMENTAL GOALS

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			6.12E6 (5,000)		14,600 (11.9)		2.2
Water, $\mu g/l$ (ppm Wt)			9.2E7		84,000		
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			14,600 (11.9)		
Water, $\mu g/l$ (ppm Wt)			84,000		
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 1A

WLN: 3H

STRUCTURE:

$CH_3CH_2CH_3$

PROPANE: C_3H_8 (dimethylmethane).
A colorless, flammable gas.

PROPERTIES:

Molecular wt: 44.09; bp: -42.1; d: $0.5854^{-44.5}$;
vap. d: 1.56; slightly soluble; vap. press.: 760 mm at -42.1°.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Rural background concentration in air is reported as 1.4 to 8.4 ppbc (ref. 1). This is equivalent to 0.84 to 5.0 $\mu g/m^3$.

TOXIC PROPERTIES, HEALTH EFFECTS:

No significant physiologic properties are reported for exposed workers.
Aquatic toxicity: TLm 96: over 1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Classified by ACGIH as a simple asphyxiant.
TLV_{SA} = 5,000 ppm or 9,000 mg/m^3.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 9.00×10^6 $\mu g/m^3$ (5,000 ppm)
Water, Health: $15 \times 9.0 \times 10^6 = 1.35 \times 10^8$ $\mu g/\ell$
Land, Health:

Air, Ecology:
Water, Ecology: $100 \times >1{,}000 = >1.0 \times 10^5$ $\mu g/\ell$
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 9{,}000/420 = 21{,}400$ $\mu g/m^3$
$EPC_{AH1a} = 5{,}000/420 = 11.9$ ppm
$EPC_{WH1} = 15 \times 21{,}400 = 3.2 \times 10^5$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 9{,}000 = 1.2 \times 10^5$ $\mu g/\ell$

$EPC_{WE1} = 50 \times >1{,}000 = >50{,}000$ $\mu g/\ell$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			9.0E6 (5,000)		21,400 (11.9)		0.84-5.0
Water, $\mu g/l$ (ppm Wt)			1.35E8	>1.0E5	120,000	>50,000	
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			21,400 (11.9)		
Water, $\mu g/l$ (ppm Wt)			120,000	> 50,000	
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 1A

WLN: 4H

BUTANES: C_4H_{10}

- n-BUTANE:
- ISOBUTANE: (trimethylmethane, 2-methylpropane).

Colorless gas; faint disagreeable odor.

STRUCTURE:

$CH_3-CH_2-CH_2-CH_3$
n-butane

CH_3
$CH_3-CH-CH_3$
isobutane

PROPERTIES:

n-butane: mol. wt: 58.1; bp: -0.1; d: 0.599;
vap. press: 2 atm at 18.8°; vap. d: 2.046; soluble.
isobutane: mol. wt.: 58.1; bp: -0.5; d: 0.557;
vap. press: 760 mm at -11.7°; vap. d: 2.01; soluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Participation in photooxidation reactions is extremely limited (ref. 3). Isobutane is more reactive than n-butane and forms isobutyl and tertiary butyl radicals. Rural background concentration is reported as 1.1 to 19.5 ppbc for n-butane (ref. 1). This is equivalent to 0.65 to 11.5 $\mu g/m^3$. A level of 0.8 ppb isobutane is reported in urban atmosphere (ref. 1). This is equivalent to 1.8 $\mu g/m^3$. The odor detection limit for butanes is 5,000 ppm (ref. 4).

TOXIC PROPERTIES, HEALTH EFFECTS:

Exposure to high concentrations of butane produces narcosis (ref. 4).
LC_{50} for n-butane (inhalation, rat): 658 mg/m^3 (24 hours).
Aquatic toxicity for n-butane: TLm 96: > 1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 1,400 mg/m^3 (600 ppm) for n-butane
Classified by ACGIH as a simple asphyxiant.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.40×10^6 $\mu g/m^3$ (600 ppm)
Water, Health: $15 \times 1.4 \times 10^6 = 2.1 \times 10^7$ $\mu g/\ell$
Land, Health:

Air, Ecology:
Water, Ecology: $100 \times >1,000 => 1.0 \times 10^5$ $\mu g/\ell$
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 1.400/420 = 3,450$ $\mu g/m^3$
$EPC_{AH1a} = 600/420 = 1.43$ ppm
$EPC_{WH1} = 15 \times 3,450 = 52,000$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 1,400 = 19,000$ $\mu g/\ell$

$EPC_{WE1} = 50 \times >1,000 = >50,000$ $\mu g/\ell$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.4E6 (600)		3,450 (1.43)		0.65-11.5
Water, μg/l (ppm Wt)			2.1E7	>1.0E5	19,000	>50,000	
Land, μg/g (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			3,450 (1.43)		
Water, μg/l (ppm Wt)			19,000	> 50,000	
Land, μg/g (ppm Wt)					

CATEGORY: 1B

WLN: 1 U1

ETHYLENE: C_2H_4 (ethene)

A colorless, flammable gas with sweet odor and taste.

STRUCTURE:

$H_2C{=}CH_2$

PROPERTIES:

Molecular wt: 28; mp: -169.4; bp: 103.9;
d: 0.610; vap. d.: 0.98; vap. press.: 760 mm at -103.7;
slightly soluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Rural background concentration in air is reported as 2.9 to 41.6 ppbc(ref. 1). This is equivalent to 1.7 to 24 $\mu g/m^3$. Ethylene participates to a limited extent in photooxidation reactions (ref. 3).

Ethylene is produced naturally by plants and acts as a plant hormone (ref. 5).

TOXIC PROPERTIES, HEALTH EFFECTS:

No significant physiologic properties are reported for exposed workers. Toxicity to plants: Exposure to 0.04 ppm for 3-4 hours is reported to cause leaf epinasty in tomato (ref. 6); exposure to 0.001 ppm for 1 day has resulted in leaf epinasty in African marigold (ref. 7). Ethylene "is the only hydrocarbon that should have adverse effects on vegetation at ambient concentrations of 1 ppm or less." (ref. 5). Aquatic toxicity rating: TLm 96: 1,000-100 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Classified by ACGIH as simple asphyxiant.
TLV_{SA} = 5,000 ppm or 5,710 mg/m^3.
On First Priority Chemicals List of the Chemical Industry Institute of Toxicology (ref. 8).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 5.71×10^6 $\mu g/m^3$ (5,000 ppm)
Water, Health: $15 \times 5.7 \times 10^6 = 8.6 \times 10^7$ $\mu g/\ell$
Land, Health:

Air, Ecology: 1.00 $\mu g/m^3$
Water, Ecology: $100 \times 100 = 10^4$ $\mu g/\ell$
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 5{,}710/420 = 13{,}600$ $\mu g/m^3$
$EPC_{AH1a} = 5{,}000/420 = 11.9$ ppm
$EPC_{WH1} = 15 \times 13{,}600 = 2.0 \times 10^5$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 5{,}710 = 7.9 \times 10^4$ $\mu g/\ell$

$EPC_{AE} = 0.1 \times 1 = 0.1$ $\mu g/m^3$
$EPC_{WE} = 50 \times 100 = 5{,}000$ $\mu g/\ell$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.71E6 (5,000)	1.0E0	13,600 (11.9)	0.1	1.7-24
Water, $\mu g/l$ (ppm Wt)			8.6E7	1.0E4	79,000	5,000	
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			13,600 (11.9)	0.1	
Water, $\mu g/l$ (ppm Wt)			79,000	5,000	
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 1B

WLN: 2U1

PROPYLENE: C_3H_6 (propane).
A colorless flammable gas.

STRUCTURE:

```
  H H
H-C=C-CH3
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PROPERTIES:

Molecular wt.: 42.1; mp: -185; bp: -47.7; d: (liquid) 0.581; vap. press.: 10 atm. at 19.8; vap. d.: 1.5; soluble

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Rural background levels in air are reported as 0.6 to 2.9 ppbc (ref. 1). This is equivalent to 0.34 to 1.7 $\mu g/m^3$. Propylene participates substantially in photooxidation reactions (ref. 3).

TOXIC PROPERTIES, HEALTH EFFECTS:

No significant physiologic properties are reported for exposed workers.

Toxicity to plants: Exposure to 50 ppm for 48 hours produces epinasty in tomato petiole; 72 hour exposure to 1,000 ppm causes declination in sweet pea seedlings (ref. 3). 50 ppm is equivalent to 86,000 $\mu g/m^3$.

High concentrations of propylene in water tend to increase the biological oxygen demand.

Aquatic toxicity rating: TL_m 96: over 1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Classified by ACGIH as simple asphyxiant.

TLV_{SA} = 5,000 ppm. This is equivalent to 8,600 mg/m^3.

Water criteria for total dissolved gases applies.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 8.6×10^6 $\mu g/m^3$ (5,000 ppm)

Water, Health: $15 \times 8.6 \times 10^5 = 1.3 \times 10^7$ $\mu g/\ell$

Land, Health:

Air, Ecology: $86{,}000 \times 48/24 = 1.7 \times 10^5$ $\mu g/m^3$

Water, Ecology: $100 \times >1{,}000 = 10^5$ $\mu g/\ell$

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 8{,}600/420 = 20{,}000$ $\mu g/\ell$

$EPC_{AH1a} = 5{,}000/420 = 11.9$ ppm

$EPC_{WH1} = 15 \times 20{,}000 = 3 \times 10^5$ $\mu g/\ell$

$EPC_{WH2} = 13.8 \times 8{,}600 = 1.2 \times 10^5$ $\mu g/\ell$

$EPC_{AE} = 0.1 \times 86{,}000 \times 2 = 1.7 \times 10^4$ $\mu g/m^3$

$EPC_{WE1} = 50 \times >1{,}000 = >50{,}000$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			8.6E6 (5,000)	1.7E5	20,000 (11.9)	17,000	0.34-1.7
Water, $\mu g/l$ (ppm Wt)			1.3E7	>1.0E5	120,000	>50,000	
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			20,000 (11.9)	17,000	
Water, $\mu g/l$ (ppm Wt)				>50,000	
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 1C

WLN:

STRUCTURE:

$HC \equiv CH$

ACETYLENE: C_2H_2 (ethyne, ethine).
A colorless, flammable gas with garlic odor.

PROPERTIES:

Molecular wt: 26.04; mp: -81.8; bp: -84.0; d: 0.6181_4^{-32};
vap. press.: 40 atm at 16.8°C; vap. d: 0.91; slightly soluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Rural concentration in air is reported as 0.9 to 11.4 ppbc (ref. 1). This is equivalent to 0.48 to 6.0 μg/m^3. Acetylene participates to a very limited extent in photooxidation reactions (ref. 3).

TOXIC PROPERTIES, HEALTH EFFECTS:

No significant physiologic properties are reported for exposed workers. Toxicity to plants--exposure to 50 ppm for 48 hours causes epinasty in tomato petiole; exposure to 250 ppm for 72 hours causes declination in sweet pea seedlings (ref. 3). 50 ppm is equivalent to 53 mg/m^3.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Acetylene is classified by ACGIH as a simple asphyxiant.
TLV_{SA} = 5,000 ppm or 5,300 mg/m^3.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 5.31×10^6 μg/m^3 (5,000 ppm)
Water, Health: $15 \times 5.31 \times 10^6 = 8.0 \times 10^7$ μg/ℓ
Land, Health:

Air, Ecology: $53{,}000 \times 2 = 1.06 \times 10^5$ μg/m^3 (100 ppm)
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 5{,}300/420 = 12{,}600$ μg/m^3
$EPC_{AH1a} = 5{,}000/420 = 11.9$ ppm
$EPC_{WH1} = 15 \times 12{,}600 = 1.9 \times 10^5$ μg/ℓ
$EPC_{WH2} = 13.8 \times 5{,}300 = 7.3 \times 10^4$ μg/ℓ

$EPC_{AE} = 0.1 \times 53{,}000 \times 2 = 10{,}600$ μg/m^3 (10 ppm)

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			5.31E6 (5,000)	1.06E5 (100)	12,600 (11.9)	10,600 (10)	
Water, μg/l (ppm Wt)			8.0E7		73,000		
Land, μg/g (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			12,600 (11.9)	10,600 (10)	
Water, μg/l (ppm Wt)			73,000		
Land, μg/g (ppm Wt)					

CATEGORY: 2A

WLN: G1

METHYL CHLORIDE: CH_3Cl (chloromethane).
A colorless, poisonous gas.

STRUCTURE:

```
    H
    |
H — C — Cl
    |
    H
```

PROPERTIES:

Molecular wt: 50.49; mp: -97.73; bp: -24.2;
d: 0.9159^{20}_{4}; vap. d: 1.78; vap. press: 5 atmospheres at 22° C; slightly soluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The concentration of methyl chloride in rural atmosphere is reported as 530 ppt (ref. 1). This is equivalent to 0.530 ppb or 1.09 $\mu g/m^3$. The odor recognition level for methyl chloride is 22.5 mg/m^3 (ref. 3).

Methyl chloride may be explosive in air in range of 10.7 to 17.2 percent by volume (ref. 9).

TOXIC PROPERTIES, HEALTH EFFECTS:

Methyl chloride as well as its metabolites, methanol and hydrochloric acid, are toxic to animals and humans. Severe poisoning results in effects to the central nervous system and other effects upon the liver, kidneys, and bone marrow (ref. 9). Concentrations below 30 ppm (average time-weighed exposure) appear to have no effect on exposed workers (ref. 4).

LD_{50} (oral, rat): 1,800 mg/kg.
LD_{Lo} (inhalation, rat): 6,500 mg/m^3.
Aquatic toxicity: TLm 96: over 1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 210 mg/m^3 (100 ppm).

Chlorinated hydrocarbons are under consideration for addition to the list of compounds for Toxic Effluent Standards (ref. 10).

On EPA Consent Decree Priority II List.

Candidate for Second Priority Chemical List of the Chemical Industry. Institute of Toxicology (ref. 11).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2.1×10^5 $\mu g/m^3$ (100 ppm)
Water, Health: $15 \times 2.1 \times 10^5 = 3.2 \times 10^6$ $\mu g/\ell$
Land, Health: $0.002 \times 3.2 \times 10^6 = 6.4 \times 10^3$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times >1{,}000 = >1.0 \times 10^5$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^5 = 200$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 210/420 = 500$ $\mu g/m^3$
$EPC_{AH1a} = 100/420 = 0.24$ ppm
$EPC_{WH1} = 15 \times 500 = 7{,}500$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 210 = 2{,}900$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 2{,}900 = 5.8$ $\mu g/g$

$EPC_{WE1} = 50 \times >1{,}000 = >50{,}000$ $\mu g/\ell$
$EPC_{LE} = 0.002 \times 50{,}000 = 100$ $\mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.1E5 (100)		500 (0.24)		1
Water, $\mu g/l$ (ppm Wt)			3.2E6	>1.0E5	2,900	50,000	
Land, $\mu g/g$ (ppm Wt)			6.4E3	2.0E2	5.8	100	

*To be multiplied by dilution factor

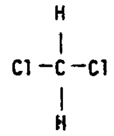
AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			500 (0.24)		
Water, $\mu g/l$ (ppm Wt)			2,900	>50,000	
Land, $\mu g/g$ (ppm Wt)			5.8	100	

CATEGORY: 2A

WLN: G1G

STRUCTURE:



METHYLENE CHLORIDE: CH_2Cl_2 (dichloromethane, methylene bichloride).
A colorless liquid.

PROPERTIES:

Molecular wt: 84.94; mp: -95.1; bp: 40; d: 1.3266_4^{20}; vap. press: 400 mm at 24.1° C; vap. d: 2.93; soluble in about 50 parts water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The concentration of dichloromethane in rural atmosphere is reported as 3.0 ppt (ref. 1). This is equivalent to 0.003 ppb or 0.01 μg/m^3. The odor threshold ranges from 25 to 50 ppm (ref. 9).

Dichloromethane is permitted as an additive to food for human consumption by the Food and Drug Administration (ref. 12). Its principle use is as a solvent in food processing.

Methylene chloride has been identified in samples from public drinking water supplies in concentrations of < 5.0 μg/ℓ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Methylene chloride is probably the least toxic of the chlorinated hydrocarbon solvents (ref. 4). The primary effect of exposure via inhalation is temporary narcosis; it is, however, dangerous to the eyes (ref. 9). Severe poisoning has resulted from exposure to very high concentrations (several thousand ppm). Exposure to 500 ppm for 8 hours via inhalation is reported to result in toxic effects to the blood of a human; exposure to 500 ppm for 1 yr has resulted in effects to the central nervous system (ref. 2). Tests on nearly 2,000 animals at levels as high as 3,500 ppm show dichloromethane to be relatively innocuous, and did not indicate any carcinogenic response (ref. 14).

LD_{50} (oral, rat): 2,136 mg/kg.
LC_{Lo} (inhalation, guinea pig): 5,000 ppm/2 hr.
Aquatic toxicity: TLm 96: 1,000-100 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Methylene chloride is the subject of a NIOSH Criteria Document. Recommendation for occupational exposure is 75 ppm, time-weighted average, with a peak concentration of 500 ppm (ref. 15). 75 ppm is equivalent to approximately 260 mg/m^3.
TLV = 720 mg/m^3 (200 ppm).
On EPA Consent Decree List, Priority 2.
On Chemical Industry Institute of Toxicology Priority 1 List (ref. 8).
Chlorinated hydrocarbons are under consideration for addition to the list of compounds for Toxic Effluent Standards (ref. 10).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2.60×10^5 μg/m^3 (75 ppm)
Water, Health: $15 \times 2.60 \times 10^5 = 3.9 \times 10^6$ μg/ℓ
Land, Health: $0.002 \times 3.9 \times 10^6 = 7.8 \times 10^3$ μg/g

Air, Ecology:
Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ μg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 260/420 = 619$ μg/m^3
$EPC_{WH1} = 15 \times 619 = 9{,}180$ μg/ℓ
$EPC_{WH1} = 13.8 \times 260 = 3{,}590$ μg/ℓ
$EPC_{LH} = 0.002 \times 3{,}590 = 7.2$ μg/g

$EPC_{WE1} = 50 \times 100 = 5{,}000$ μg/ℓ
$EPC_{LE} = 0.002 \times 5{,}000 = 10$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.6E5 (75)		619		0.01
Water, $\mu g/l$ (ppm Wt)			3.9E6	1.0E4	3,590	5000	<5 †
Land, $\mu g/g$ (ppm Wt)			7.8E3	2.0E1	7.2	10	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			619		
Water, $\mu g/l$ (ppm Wt)			3,590	5,000	
Land, $\mu g/g$ (ppm Wt)			7.2	10	

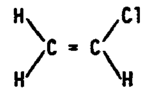
† Public drinking water.

CATEGORY: 2B

WLN: G1U1

VINYL CHLORIDE: CH_2CHCl (chloroethene, chloroethylene).
A colorless liquid or gas.

STRUCTURE:



PROPERTIES:

Molecular wt: 62.50; mp: -153.8; bp: -13.37; d: 0.9106_4^{15}; vap. d: 2.15; vap. press: 2,600 mm at 25° C; slightly soluble; flammable.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Chloroethene polymerizes in light or in presence of a catalyst. Chloroethene releases phosgene and hydrogen chloride when heated to decomposition.

The concentration of chloroethene in rural atmosphere is reported as < 5 ppt (ref. 1). This is equivalent to < 0.005 ppb or < 0.013 $\mu g/m^3$.

Vinyl chloride has been identified in samples of public drinking water supplies in concentrations of 10 $\mu g/\ell$ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Chloroethene acts as an anesthetic at high concentrations. There is a wide margin between the anesthetic and lethal concentrations (ref. 4). Circulatory and bone changes in the fingertips of workers handling chloroethene are reported (ref. 9). Chloroethene has been associated with a rare form of liver cancer.

Chloroethene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 7323. The carcinogenic responses resulted from exposure via inhalation; the lowest dosage reported is 250 ppm administered for 4 hr/day for 260 days to a rat. Assuming total absorption of material in the air breathed, breathing volume of 0.73 ℓ/min and weight of rat as 0.113 kg (ref. 3), the dosage corresponds to 25.6 g/kg. The adjusted ordering number calculated using this number is extremely small. Since cancer in humans has been associated with chloroethene, further study is warranted for determining a permissible concentration.

Aquatic toxicity: TLm 96: over 1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 510 mg/m^3 (200 ppm). (Vinyl chloride is classified by ACGIH as a human carcinogen. Reassignment of TLV is pending further data acquisition.)

National Emission Standards for Hazardous Air Pollutants include standards of emissions of vinyl chloride from vinyl chloride manufacturers or polyvinyl chloride manufacturers (ref. 16).

OSHA Standard for Exposure to Vinyl Chloride: 1 ppm 8 hr/day time-weighted exposure (ref. 17). 1 ppm is equivalent to 2.55 mg/m^3.

NIOSH recommended standard for occupational exposure in polymerization facilities is to eliminate exposure at detectable levels (ref. 18). EPA Consent Decree Priority 1 List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2.55×10^3 $\mu g/m^3$

Water, Health: $15 \times 2.55 \times 10^3 = 3.8 \times 10^4$ $\mu g/\ell$

Land, Health: $0.002 \times 3.8 \times 10^4 = 76$ $\mu g/\ell$

Air, Ecology:

Water, Ecology: $100 \times 1{,}000 = 1.0 \times 10^5$ $\mu g/\ell$

Land, Ecology: $0.002 \times 1.0 \times 10^5 = 200$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 510/420 = 1{,}200$ $\mu g/m^3$

$EPC_{AH1a} = 200/420 = 0.5$ ppm

$EPC_{WH1} = 15 \times 1{,}200 = 18{,}000$ $\mu g/\ell$

$EPC_{WH2} = 13.8 \times 510 = 7{,}040$ $\mu g/\ell$

$EPC_{LH} = 0.002 \times 7{,}038 = 14$ $\mu g/g$

$EPC_{AC1} = 10^3 \times 2.55/420 = 6$ $\mu g/m^3$

$EPC_{AC1a} = 1/420 = 0.002$ ppm

$EPC_{WC} = 15 \times 6 = 90$ $\mu g/\ell$

$EPC_{LC} = 0.002 \times 90 = 0.2$ $\mu g/g$

$EPC_{WE1} = 50 \times >1{,}000 = >50{,}000$ $\mu g/\ell$

$EPC_{LE} = 0.002 \times 50{,}000 = 100$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, µg/m³ (ppm Vol)			2.55E3		6 (0.002)		<0.01
Water, µg/l (ppm Wt)			3.8E4	>1.0E5	90	>50,000	<10 †
Land, µg/g (ppm Wt)			7.6E1	2.0E2	0.2	100	

*To be multiplied by dilution factor

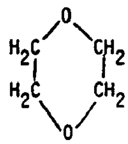
	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, µg/m³ (ppm Vol)			1,200 (0.5)		6 (0.002)
Water, µg/l (ppm Wt)			7,040	>50,000	90
Land, µg/g (ppm Wt)			14	100	0.2

† Public drinking water.

CATEGORY: 3

WLN: T6O DOTJ

STRUCTURE:



1,4-DIOXANE: $C_4H_8O_2$ (1,4-diethylene dioxide).
A colorless, flammable liquid with a faint odor.

PROPERTIES:

Molecular wt: 88.10; mp: 11; bp: 101^{750}; d: 1.030;
vap. press: 40 mm at 25.2; miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

All ethers tend to form explosive peroxides.
The odor-recognition level for 1,4-dioxane is reported as 620 mg/m^3 (ref. 3).

TOXIC PROPERTIES, HEALTH EFFECTS:

High concentrations of dioxane vapor produce eye, nose, and lung irritation, and cause severe damage to kidneys and liver. A human death has been reported resulting from one week exposure to an average concentration of 470 ppm of dioxane vapors (ref. 4). Exposure to 5,500 ppm for 1 minute caused eye effects (ref. 2). Dioxane may be absorbed through the skin.

LD_{50} (oral, rat): 7,120 mg/kg.

Dioxane appears in the NIOSH Suspected Carcinogens List. The ordering number is 4111. The lowest dose to induce a carcinogenic response is reported as 416 mg/kg. The adjusted ordering number is 0.01.

Aquatic toxicity: TLm 96: 1,000 - 100 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 180 mg/m^3 (50 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.80×10^5 μg/m^3 (50 ppm)
Water, Health: $15 \times 1.80 \times 10^5 = 2.7 \times 10^6$ μg/ℓ
Land, Health: $0.002 \times 2.7 \times 10^6 = 5.4 \times 10^3$ μg/g

Air, Ecology:
Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ μg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 180/420 = 428$ μg/m^3
$EPC_{AH1a} = 50/420 = 0.12$ ppm
$EPC_{WH1} = 15 \times 428 = 6,420$ μg/ℓ
$EPC_{WH2} = 13.8 \times 180 = 2,480$ μg/ℓ
$EPC_{LH} = 0.002 \times 2,480 = 5$ μg/g

$EPC_{WE1} = 50 \times 100 = 5,000$ μg/ℓ
$EPC_{LE} = 0.002 \times 5,000 = 10$ μg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.80E5 (50)		428 (0.12)		
Water, μg/l (ppm Wt)			2.7E6	1.0E4	2,480	5,000	
Land, μg/g (ppm Wt)			5.4E3	2.0E1	5	10	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			428 (0.12)		
Water, μg/l (ppm Wt)			2,480	5,000	
Land, μg/g (ppm Wt)			5	10	

CATEGORY: 4

WLN: G2O2G

2,2'-DICHLORODIETHYL ETHER: $C_4H_8Cl_2O$ (bis-2-chloroethyl ether).
A colorless, clear liquid with a pungent odor.

STRUCTURE:

$Cl-CH_2-CH_2-O-CH_2-CH_2-Cl$

PROPERTIES:

Molecular wt: 143.02; mp: -51.7; bp: 178; d: 1.2199;
vap. press: 1.4 mm at 25; insoluble; vap. d: 4.93.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

All ethers tend to form explosive peroxides. The odor of 2,2'-dichlorodiethyl ether is easily detected at concentrations of 35 ppm (ref. 9).

Bis(2-chloroethyl)ether has been identified in samples from public drinking water supplies in concentrations of 0.42 μg/ℓ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

2,2'-Dichlorodiethyl ether acts as an irritant to eyes and upper respiratory tract and affects the kidneys and liver in varying degrees. It is absorbed through the skin (refs. 9, 19). Concentrations of 35 ppm are nearly free of irritative effects (ref. 9).

LD_{50} (oral, rat): 75 mg/kg.

LC_{Lo} (inhalation, rat): 1,000 ppm/45 min.

2,2'-Dichlorodiethyl ether appears in the NIOSH Suspected Carcinogens List. The ordering number is 3111. The lowest dose to induce a carcinogenic response is reported as 33 gm/kg. The adjusted ordering number is 0.09.

Aquatic toxicity: TLm 96: 1,000 - 100 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 30 mg/m^3 (5 ppm).
EPA Consent Decree Priority I List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.0×10^4 μg/m^3 (5 ppm)
Water, Health: $15 \times 3.0 \times 10^4 = 4.5 \times 10^5$ μg/ℓ
Land, Health: $0.002 \times 4.5 \times 10^5 = 900$ μg/ℓ

Air, Ecology:
Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ μg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 30/420 = 71$ μg/m^3
$EPC_{AH1a} = 5/420 = 0.01$ ppm
$EPC_{WH1} = 15 \times 71 = 1,070$ μg/ℓ
$EPC_{WH2} = 13.8 \times 30 = 414$ μg/ℓ
$EPC_{LH} = 0.002 \times 414 = 0.8$ μg/g

$EPC_{WE1} = 50 \times 100 = 5,000$ μg/ℓ

$EPC_{LE} = 0.002 \times 5,000 = 10$ μg/ℓ

	EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors					
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.0E4 (5)		71 (0.01)		
Water, $\mu g/l$ (ppm Wt)			4.5E5	1.0E4	414	5,000	<0.4†
Land, $\mu g/g$ (ppm Wt)			9.0E2	2.0E1	0.8	10	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			71 (0.01)		
Water, $\mu g/l$ (ppm Wt)			414	5,000	
Land, $\mu g/g$ (ppm Wt)			0.8	10	

†Public drinking water.

CATEGORY: 5A

WLN: Q1

METHANOL: CH_4O (methyl alcohol, wood alcohol, carbinol).
A colorless, flammable, mobile liquid.

STRUCTURE:

CH_3OH

PROPERTIES:

Molecular wt: 32.04; bp: 64.96; mp: -97.8; d: 0.7914 g/ml;
vap. press: 160 mm at 59.4°; miscible with water; vap. d: 1.11.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Methanol is a product of the destructive distillation of wood. Methanol may be formed by the reaction of carbon monoxide and hydrogen in the presence of catalysts. Rural concentration in air is reported as 1.2 ppb (ref. 1). This is equivalent to 1.6 $\mu g/m^3$. The odor recognition level for methanol is reported to be as low as 4.8 mg/m^3 (ref. 3). Methanol is a common air contaminant. It is used as a food additive permitted in foods for human consumption (ref. 9).

TOXIC PROPERTIES, HEALTH EFFECTS:

Methanol possesses narcotic properties and is an irritant to the mucous membranes. It is considered a cumulative poison due to the low rate of excretion once it is absorbed. In the body, methanol is oxidized to formaldehyde and formic acid; both these metabolites are toxic. Methanol mainly affects the nervous system, particularly the optic nerve. Severe exposures may eventually cause death or blindness (ref. 9).

Methanol is absorbed through the skin. The lowest lethal oral dose for humans is listed as 340 mg/kg. Ingestion of 100 mg/kg by humans has resulted in effects to the eyes; inhalation of 300 ppm has resulted in effects to the central nervous system (ref. 2). The biological half-life for methanol is reported as 0.289 days or about 7 hours (ref. 20).

LD_{50} (oral, rat): 13 g/kg.
LC_{50} (inhalation, monkey): 1,000 ppm.
Aquatic toxicity: TLm 96 (ref. 2): over 1,000 ppm.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 260 mg/m^3 (200 ppm).

Methanol is the subject of a NIOSH Criteria Document; recommended standard is 200 ppm with a ceiling of 800 ppm (ref. 21).

Listed on Second Priority Chemical List of the Chemical Industry Institute of Toxicology (ref. 11).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2.6×10^5 $\mu g/m^3$
Water, Health: $15 \times 2.6 \times 10^5 = 3.9 \times 10^6$ $\mu g/\ell$
Land, Health: $0.002 \times 3.9 \times 10^6 = 7.8 \times 10^3$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times >1,000 = >1.0 \times 10^5$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^5 = 200$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 260/420 = 619$ $\mu g/m^3$
$EPC_{AH1a} = 200/420 = 0.5$ ppm
$EPC_{WH1} = 15 \times 619 = 9,300$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 260 = 3,600$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 3,600 = 7.2$ $\mu g/g$

$EPC_{WE1} = 50 \times >1,000 = >50,000$ $\mu g/\ell$

$EPC_{LE} = 0.002 \times 50,000 = 100$ $\mu g/g$

MULTIMEDIA ENVIRONMENTAL GOALS

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.6E5		619 (0.5)		1.6
Water, $\mu g/l$ (ppm Wt)			3.9E6	>1.0E5	3,600	>50,000	
Land, $\mu g/g$ (ppm Wt)			7.8E3	2.0E2	7.2	100	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			619 (0.5)		
Water, $\mu g/l$ (ppm Wt)			3,600	>50,000	
Land, $\mu g/g$ (ppm Wt)			7.2	100	

CATEGORY: 5A

WLN: Q2

STRUCTURE:

CH_3CH_2OH

ETHANOL: C_2H_6O (ethyl alcohol, grain alcohol).
A clear, flammable, colorless, fragrant liquid with a burning taste.

PROPERTIES:

Molecular wt: 46.07; bp: 78.5; mp: -116; d: 0.7893; vap. press: 275 mm at 54.8°; completely miscible with water; vap. d: 1.59.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Ethyl alcohol is produced commercially by the fermentation of grains or molasses. Ingestion causes an inebriating effect.

Rural concentration in air is reported as 1.2 ppb (ref. 1). This is equivalent to 2.25 μg/m^3.

The odor recognition level for ethanol in air is 21-93 mg/m^3 (ref. 3).

Ethanol has been identified in samples from public water supplies in concentrations of 5 μg/ℓ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Ethyl alcohol is rapidly oxidized in the body, mainly to carbon dioxide and water. Cumulative effects do not occur, but repeated ingestion can lead to chronic alcoholism. Exposure to concentrations over 1,000 ppm may cause headaches, irritation to upper respiratory tract and eyes, and drowsiness and inability to concentrate (ref. 9). The lowest lethal dose reported for humans is 2,000 mg/kg. The lowest toxic dose reported is 50 mg/kg (ref. 2). The biological half-life for ethanol is reported as 10 hours (ref. 22).

LD_{50} (oral, rat): 13.7 g/kg (ref. 9).

Carcinogenic effects in mice have been observed as a result of large doses. The EPA/NIOSH ordering number is 3112. The lowest dose resulting in a carcinogenic effect is 100 gm/kg. The adjusted ordering number is 0.03. The compound is not considered a highly active carcinogen.

Aquatic toxicity: TLm 96: >1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 1,900 mg/m^3 (1,000 ppm) (based primarily on irritative rather than toxic properties).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.9×10^6 μg/m^3

Water, Health: $15 \times 1.9 \times 10^6 = 2.9 \times 10^7$ μg/ℓ

Land, Health: $0.002 \times 2.9 \times 10^7 = 5.8 \times 10^4$ μg/g

Air, Ecology:

Water, Ecology: $100 \times >1{,}000 = >1.0 \times 10^5$ μg/ℓ

Land, Ecology: $0.002 \times 1.0 \times 10^5 = 200$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 1{,}900/420 = 4{,}520$ μg/m^3

$EPC_{AH1a} = 1{,}000/420 = 2.4$ ppm

$EPC_{WH1} = 15 \times 4{,}520 = 68{,}000$ μg/ℓ

$EPC_{WH2} = 13.8 \times 1{,}900 = 26{,}000$ μg/ℓ

$EPC_{LH} = 0.002 \times 26{,}000 = 52$ μg/g

$EPC_{WE1} = 50 \times >1{,}000 = >50{,}000$ μg/ℓ

$EPC_{LE} = 0.002 \times 50{,}000 = 100$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.9E6		4,520 (2.4)		2.25
Water, μg/l (ppm Wt)			2.9E7	>1.0E5	26,000	>50,000	<5†
Land, μg/g (ppm Wt)			5.8E4	2.0E2	52	100	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			4,520 (2.4)		
Water, μg/l (ppm Wt)			26,000	>50,000	
Land, μg/g (ppm Wt)			52	100	

†Public drinking water.

CATEGORY: 5A

WLN: Q3

1-PROPANOL: C_3H_8O (n-propyl alcohol, 1-hydroxypropane). A colorless, volatile liquid.

STRUCTURE:

$CH_3CH_2CH_2OH$

PROPERTIES:

Molecular wt: 60.09; bp: 97.1; mp: -126.1; d: 0.8044; vap. press.: 198 mm (65.94° C); very soluble in water; vap. d: 2.08.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

In industrial areas, ambient concentration of 1-propanol is reported as 61.8 ppm, or 152 mg/m^3 (ref. 1).

Propanol is not used as extensively as other alcohols; uses include solvents, synthetic resins, laquers, cleaners, and pharmaceuticals (ref. 23).

Propanol has been identified in samples from public drinking water supplies at a concentration of 1.0 μg/ℓ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

1-Propanol is slightly more toxic than 2-propanol, which is not considered an important toxic hazard (ref. 9). The principal action of 1-propanol is that of a mild narcotic (ref. 4). Depressant action is similar to ethyl alcohol (ref. 24).

Ingestion of 5,700 mg/kg of 1-propanol resulted in death for a human (ref. 2).

LD_{50}(oral, rat): 1,870 mg/kg.

LC_{Lo}(inhalation, rat): 4,000 ppm/4 hr.

The compound has produced carcinogenic effects in rats at very high dosages. The EPA/NIOSH ordering number is 4112. The lowest dosage to produce a carcinogenic response is reported as 6 g/kg. The adjusted ordering number is 0.7. Propanol is not considered a highly active carcinogen.

Aquatic toxicity: TLm 96: 1,000-100 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 500 mg/m^3 (200 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 5.0×10^5 $\mu g/m^3$ (200 ppm)
Water, Health: $15 \times 5.0 \times 10^5 = 7.5 \times 10^6$ μg/ℓ
Land, Health: $0.002 \times 7.5 \times 10^6 = 1.5 \times 10^4$ μg/g

Air, Ecology:
Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ μg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 500/420 = 1{,}200$ $\mu g/m^3$
$EPC_{AH1a} = 200/420 = 0.5$ ppm
$EPC_{WH1} = 15 \times 1{,}200 = 18{,}000$ μg/ℓ
$EPC_{WH2} = 13.8 \times 500 = 6{,}900$ μg/ℓ
$EPC_{LH} = 0.002 \times 6{,}900 = 13.8$ μg/g

$EPC_{WE1} = 50 \times 100 = 5{,}000$ μg/ℓ
$EPC_{LE} = 0.002 \times 5{,}000 = 10$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			5.0E5		1,200 (0.5)		152,000 (61.8)†
Water, μg/l (ppm Wt)			7.5E6	1.0E4	6,900	5,000	1‡
Land, μg/g (ppm Wt)			1.5E4	2.0E1	13.8	10	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			1,200 (0.5)		
Water, μg/l (ppm Wt)			6,900	5,000	
Land, μg/g (ppm Wt)			13.8	10	

†Value is reported for industrial areas. No rural concentration is reported.
‡Public drinking water.

CATEGORY: 5A

WLN: Q4

n-BUTANOL: $C_4H_{10}O$ (butyl alcohol).
A colorless, volatile liquid.

STRUCTURE:

$CH_3CH_2CH_2CH_2OH$

1-Butanol

PROPERTIES:

Molecular wt: 74.12; mp: -79.9; bp: 117.7;
d: $.8109^{20}_{20}$; vap. d: 2.56; vap. press.: 6.5 mm at 25°;
solubility: 7.7 percent in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The rural concentration for 1-butanol is reported as 126 ppb (ref. 1). This is equivalent to 381 $\mu g/m^3$. The odor recognition level for 1-butanol is reported as 33 mg/m^3 (ref. 3).

TOXIC PROPERTIES, HEALTH EFFECTS:

Due to low volatility, few cases of poisoning in industry have been reported. Toxic effects of n-butanol include eye irritation with corneal inflammation, slight headache and dizziness, slight irritation of nose and throat, and dermatitis on fingers (ref. 9). No narcotic or irritative effects are anticipated at 100 ppm (302 mg/m^3) (ref. 4), although inhalation by humans at 25 ppm (76 mg/m^3) has been reported to cause irritative effects (ref. 2).

LD_{50} (oral, rat): 790 mg/kg.
LC_{50} (inhalation, rat): 78,000 ppm for 4 hours (ref. 4).
Aquatic toxicity: TLm 96: over 1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 150 mg/m^3 (50 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.50×10^5 $\mu g/m^3$ (50 ppm)
Water, Health: $15 \times 1.5 \times 10^5 = 2.25 \times 10^6$ $\mu g/\ell$
Land, Health: $0.002 \times 2.25 \times 10^6 = 4.5 \times 10^3$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times >1,000 = >1.0 \times 10^5$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^5 = 200$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 150/420 = 357$ $\mu g/m^3$
$EPC_{AH1a} = 50/420 = 0.12$ ppm
$EPC_{WH1} = 15 \times 357 = 5,400$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 150 = 2,070$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 2,070 = 4$ $\mu g/g$

$EPC_{WE1} = 50 \times >1,000 = >50,000$ $\mu g/\ell$

$EPC_{LE} = 0.002 \times 50,000 = 100$ $\mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.50E5 (50)		357 (0.12)		381
Water, μg/l (ppm Wt)			2.25E6	>1.0E5	2,070	>50,000	
Land, μg/g (ppm Wt)			4.5E3	2.0E2	4	100	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			357 (0.12)		
Water, μg/l (ppm Wt)			2,070	>50,000	
Land, μg/g (ppm Wt)			4	100	

CATEGORY: 5A

WLN:

ISOBUTYL ALCOHOL: $C_4H_{10}O$ (2-methyl-1-propanol, isobutanol). A clear, sweet-smelling liquid.

STRUCTURE:

CH_3CHCH_2OH
$\quad\;\; |$
$\quad CH_3$

2-Methyl-1-propanol
(Isobutyl alcohol)

PROPERTIES:

Molecular wt: 74.12; bp: 108.3; fp: -108; d: 0.8032^{20}_{20}; vap. d: 2.56; vap. press.: 12.2 mm at 25°; solubility: 10 percent in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Isobutyl alcohol has a higher vapor pressure than 1-butanol; hence, under similar conditions, higher concentrations of isobutyl alcohol will be encountered (ref. 23).

TOXIC PROPERTIES, HEALTH EFFECTS:

Isobutyl alcohol is considered more toxic than 1-butanol (ref. 4). It may be a skin irritant (ref. 23). Effects of exposure to high air concentrations have caused eye and throat irritation, loss of appetite and weight, and corneal effects (ref. 23). It acts as a narcotic in high concentrations (ref. 24).

LD_{50} (oral, rat): 2,460 mg/kg.

LC_{Lo} (inhalation, rat): 8,000 ppm for 4 hours.

Isobutyl alcohol has produced carcinogenic effects in rats at very high dosages. The EPA/NIOSH ordering number is 4112. The lowest dose to produce carcinogenic effects is 9 g/kg. The adjusted ordering number is 0.5. The compound is not considered a highly active carcinogen.

Aquatic toxicity: TLm 96: 1,000-100 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 150 mg/m^3 (50 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.50×10^5 $\mu g/m^3$ (50 ppm)
Water, Health: $15 \times 1.5 \times 10^5 = 2.25 \times 10^6$ $\mu g/\ell$
Land, Health: $0.002 \times 2.25 \times 10^6 = 4.5 \times 10^3$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 150/420 = 357$ $\mu g/m^3$
$EPC_{AH1a} = 150/420 = 0.12$ ppm
$EPC_{WH1} = 15 \times 357 = 5{,}400$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 150 = 2{,}070$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 2{,}070 = 4$ $\mu g/g$

$EPC_{WE1} = 50 \times 100 = 5{,}000$ $\mu g/\ell$
$EPC_{LE} = 0.002 \times 5{,}000 = 10$ $\mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.50E5 (50)		357 (0.12)		
Water, μg/l (ppm Wt)			2.25E6	1.0E4	2,070	5,000	
Land, μg/g (ppm Wt)			4.5E3	2.0E1	4	10	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			357 (0.12)		
Water, μg/l (ppm Wt)			2,070	5,000	
Land, μg/g (ppm Wt)			4	10	

CATEGORY: 5A

PENTANOLS, primary: $C_5H_{12}O$ (amyl alcohols).

n-Pentanol: clear liquid, mild characteristic odor.
2-Methyl-1-butanol: liquid.
2,2 -Dimethyl-1-propanol: volatile crystals, peppermint odor.
3-Methyl-1-butanol: liquid; characteristic, disagreeable odor; repulsive taste; poisonous vapors.

PROPERTIES:

	molecular wt.	bp	mp	d	solubility	vap. press.	vap.d
1-pentanol	88.15	137.5	-79	0.815	slightly	1 mm at 13.6°	3.04
2-methyl-1-butanol	88.15	128		0.816	slightly	-	3.00
2,2-dimethyl-1-propanol	88.15	114	53	0.812	slightly	16 mm at 20°	
3-methyl-1-butanol	88.15	132	-117.2	0.813	slightly	1 mm at 10°	3.04

WLN/STRUCTURE:

Q5/$CH_3CH_2CH_2CH_2CH_2OH$
n-Pentanol,
(amyl alcohol)

$CH_3CH_2CH\ CH_2OH$
|
CH_3

Q1Y2/2-Methyl-1-butanol,
(active amyl alcohol)

$CH_3CHCH_2CH_2OH$
|
CH_3

Q2Y/3-Methyl-1-butanol,
(isoamyl alcohol)

CH_3
|
CH-C-CH_2OH
|
CH_3

2,2-Dimethyl-1-propanol,
(neopentyl alcohol)

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Amyl alcohols are present in fusel oils.

Pentanol has been found in samples from public drinking water supplies at concentrations of 1.0 µg/ℓ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Amyl alcohols are about 4 times as toxic as ethyl alcohol. However, they are absorbed slowly due to low volatility and low solubility in body fluids. Vapors irritate eyes and upper respiratory tract (ref. 9). 2-Methyl-1-butanol can cause giddiness, headache, coughing, nausea, vomiting, deafness, and delerium (ref. 9). 3-Methyl-1-butanol can cause central nervous system depression and narcosis (ref. 24) and has caused irritation in humans at 150 ppm (ref. 2).

1-pentanol	LD_{50} (oral,rat) 3,030 mg/kg	TD_{Lo} (oral,rat)	Aquatic toxicity TLm 96: 1,000-100 ppm (ref. 2)
2-methyl-1-butanol	4,920 mg/kg		
2,2'-dimethyl-1-propanol			
3-methyl-1-butanol	1,300 mg/kg	27 g/kg caused carcinogenic effects	

The EPA/NIOSH ordering number for 3 methyl-1-butanol is 4112. The adjusted ordering number is 0.15. It is not considered a highly active carcinogen.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (isoamyl alcohol): 360 mg/m^3 (100 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.60×10^5 µg/m^3 (100 ppm)
Water, Health: $15 \times 3.6 \times 10^5 = 5.4 \times 10^6$ µg/ℓ
Land, Health: $0.002 \times 5.4 \times 10^6 = 1.1 \times 10^4$ µg/g

Air, Ecology:
Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ µg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 360/420 = 860$ µg/m^3
$EPC_{AH1a} = 100/420 = 0.24$ ppm
$EPC_{WH1} = 15 \times 860 = 12,900$ µg/ℓ
$EPC_{WH2} = 13.8 \times 360 = 5,000$ µg/ℓ
$EPC_{LH} = 0.002 \times 5,000 = 10$ µg/g

$EPC_{WE1} = 50 \times 100 = 5,000$ µg/ℓ
$EPC_{LE} = 0.002 \times 5,000 = 10$ µg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.60E5 (100)		860 (0.24)		
Water, $\mu g/l$ (ppm Wt)			5.4E6	1.0E4	5,000	5,000	1†
Land, $\mu g/g$ (ppm Wt)			1.1E4	2.0E1	10	10	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			860 (0.24)		
Water, $\mu g/l$ (ppm Wt)			5,000	5,000	
Land, $\mu g/g$ (ppm Wt)			10	10	

†Public drinking water.

CATEGORY: 5B

WLN: QY

2-PROPANOL: C_3H_8O (isopropyl alcohol, 2-hydroxypropane). Rubbing alcohol.
A clear, colorless, volatile liquid; faint odor.

STRUCTURE:

```
CH3-CHCH3
     |
     OH
```

PROPERTIES:

Molecular wt: 60.09; bp: 82.4; mp: -88.5; d: 0.7851; vap. d: 2.07; vap. press.: 33 mm at 20° C; miscible in all proportions with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The odor threshold level for 2-propanol is approximately 90 mg/m^3 (refs. 3,25). Isopropyl alcohol is permitted in food for human consumption (ref. 9).

The ambient air concentration in industrial areas is reported as 153 ppm (ref. 1). This is equivalent to 375 mg/m^3.

Acetone has been identified as a human metabolite of 2-propanol (ref. 25).

TOXIC PROPERTIES, HEALTH EFFECTS:

2-Propanol acts as a local irritant and in high concentration as a narcotic. It can cause eye irritation, corneal burns, and other eye damage. It is not considered an important toxic hazard (refs. 4,9). Ingestion of large quantities can cause flushing, headache, dizziness, mental depression, nausea, vomiting, narcosis, anesthesia, and coma (ref. 24). Ingestion of 2,371 mg/kg caused death in a human; a concentration of 400 ppm caused irritative effects (ref. 2).

LD_{50} (oral, rat): 5,840 mg/kg.

There is no evidence that isopropyl alcohol is a carcinogen (ref. 25).

Aquatic toxicity: TLm 96: 1,000-100 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 980 mg/m^3 (400 ppm).

Isopropyl alcohol is the subject of a NIOSH Criteria Document. The NIOSH recommendation for occupational exposure, time-weighted average, is 400 ppm with a ceiling value of 800 ppm (ref. 25).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 9.8×10^5 µg/m^3 (400 ppm)
Water, Health: $15 \times 9.8 \times 10^5 = 1.5 \times 10^7$ µg/ℓ
Land, Health: $0.002 \times 1.5 \times 10^7 = 3.0 \times 10^4$ µg/g

Air, Ecology:
Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ µg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 980/420 = 2,300$ µg/m^3
$EPC_{AH1a} = 400/420 = 0.95$ ppm
$EPC_{WH1} = 15 \times 2,300 = 34,500$ µg/ℓ
$EPC_{WH2} = 13.8 \times 980 = 13,500$ µg/ℓ
$EPC_{LH} = 0.002 \times 13,500 = 27$ µg/g

$EPC_{WE1} = 50 \times 100 = 5,000$ µg/ℓ
$EPC_{LE} = 0.002 \times 5,000 = 10$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, µg/m³ (ppm Vol)			9.8E5 (400)		2,300 (0.95)		375,000†
Water, µg/l (ppm Wt)			1.5E7	1.0E4	13,500	5,000	
Land, µg/g (ppm Wt)			3.0E4	2.0E1	27	10	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, µg/m³ (ppm Vol)			2,300 (0.95)		
Water, µg/l (ppm Wt)			13,500	5,000	
Land, µg/g (ppm Wt)			27	10	

†Value is reported for industrial areas. No rural concentration is reported.

CATEGORY: 5B

WLN: QY2

2-BUTANOL: $C_4H_{10}O$ (s-butyl alcohol, sec-butyl alcohol).
A colorless, volatile liquid; wine-like odor.

STRUCTURE:

$$CH_3CH_2\underset{\displaystyle OH}{\underset{|}{C}}HCH_3$$

PROPERTIES:

Molecular wt: 74.12; bp: 99.5; mp: -89; d: 0.8084;
vap. press.: 10 mm (20° C); vap. d: 2.55; soluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

TOXIC PROPERTIES, HEALTH EFFECTS:

Indications are that 2-butanol is less toxic than n-butanol, although little information is available. The TLV is established to prevent narcotic and irritative effects (ref. 4).

LD_{50} (oral, rat): 4,400 mg/kg (ref. 4).
LD_{Lo} (inhalation, rat): 16,000 ppm/4 hr.
Aquatic toxicity: TLm 96: over 1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 450 mg/m^3 (150 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 4.5×10^5 $\mu g/m^3$ (150 ppm)
Water Health: $15 \times 4.5 \times 10^5 = 6.75 \times 10^6$ $\mu g/\ell$
Land, Health: $0.002 \times 6.75 \times 10^6 = 1.35 \times 10^4$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times >1{,}000 = >1.0 \times 10^5$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^5 = 200$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 450/420 = 1{,}070$ $\mu g/m^3$
$EPC_{AH1a} = 150/420$ ppm = 0.4 ppm
$EPC_{WH1} = 15 \times 1{,}070 = 16{,}000$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 450 = 6{,}200$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 6{,}200 = 12.4$ $\mu g/g$

$EPC_{WE1} = 50 \times >1{,}000 = >50{,}000$ $\mu g/\ell$
$EPC_{LE} = 0.002 \times 50{,}000 = 100$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.5E5 (150)		1,070 (0.4)		
Water, $\mu g/l$ (ppm Wt)			6.75E6	>1.0E5	6,200	>50,000	
Land, $\mu g/g$ (ppm Wt)			1.35E4	2.0E2	12.4	100	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			1,070 (0.4)		
Water, $\mu g/l$ (ppm Wt)			6,200	>50,000	
Land, $\mu g/g$ (ppm Wt)			12.4	100	

CATEGORY: 5B

WLN / STRUCTURE:

PENTANOLS, secondary: $C_5H_{12}O$ (amyl alcohols).
Liquid, characteristic odor.

QY3/ $CH_3CH_2CH_2CHCH_3$
OH
2-Pentanol

QY282/ $CH_3CH_2CHCH_2CH_3$
OH
3-Pentanol

$CH_3CHCHCH_3$
CH_3 OH
3-Methyl-2-butanol

PROPERTIES:

	molecular wt.	bp	d	solubility in water	vap. d
2-pentanol	88.15	119.3	0.8098_4^{20}	slightly	3.03
3-pentanol	88.15	115.6	$.815_4^{25}$	slightly	3.04
3-methyl-2-butanol	88.15	113	$.819^{20}$	slightly	3.04

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Amyl alcohols are present in fusel oil.

TOXIC PROPERTIES, HEALTH EFFECTS:

2-Pentanol irritates eyes and mucous membranes; can cause giddiness, headache, coughing, nausea, deafness, delerium, methemoglobinuria, and glycosuria (ref. 9). Isoamyl alcohol can cause throat irritation at 100 ppm (ref. 4).

	LD_{50} (oral, rat)
2-pentanol	1,470 mg/kg
3-pentanol	1,870 mg/kg
3-methyl-2-butanol	no details available

30 cc of amyl alcohols, (primary component, isoamyl alcohol), has caused death (ref. 24). Toxicity to man is considerably greater than ethanol.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 360 mg/m^3 (100 ppm for isoamyl alcohol, a primary pentanol).

(The TLV for isoamyl alcohol is a reasonable limit for the secondary pentanols as well. The LD_{50} [oral, rat] for isoamyl alcohol is 1,300 mg/kg.)

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.6×10^5 µg/m^3 (100 ppm)
Water, Health: $15 \times 3.6 \times 10^5 = 5.4 \times 10^6$ µg/ℓ
Land, Health: $0.002 \times 5.4 \times 10^6 = 1.1 \times 10^4$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 360/420 = 860$ µg/m^3
$EPC_{AH1a} = 100/420 = 0.24$ ppm
$EPC_{WH1} = 15 \times 860 = 12{,}900$ µg/ℓ
$EPC_{WH2} = 13.8 \times 360 = 5{,}000$ µg/ℓ
$EPC_{LH} = 0.002 \times 5{,}000 = 10$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.6E5 (100)		860 (0.24)		
Water, $\mu g/l$ (ppm Wt)			5.4E6		5,000		
Land, $\mu g/g$ (ppm Wt)			1.1E4		10		

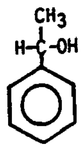
*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			860 (0.24)		
Water, $\mu g/l$ (ppm Wt)			5,000		
Land, $\mu g/g$ (ppm Wt)			10		

CATEGORY: 5B

WLN: QYR

STRUCTURE:



1-PHENYLETHANOL: $C_8H_{10}O$ (methylphenylcarbinol, α-methylbenzyl alcohol).

PROPERTIES:

Molecular wt: 122.18; bp: 203; fp: 21.4; d: 1.0129; vap. press.: 0.1 mm at 20°; vap. d: 4.21.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

TOXIC PROPERTIES, HEALTH EFFECTS:

No information is available concerning the toxic effects of 1-phenylethanol.

LD_{50} (oral, rat): 400 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 45 x 400 = 1.8×10^4 μg/m^3

Water, Health: 15 x 1.8×10^4 = 2.7×10^5 μg/ℓ

Land, Health: 0.002 x 2.7×10^5 = 540 μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH2} = 0.107 x 400 = 43 μg/m^3

EPC_{AH3} = 0.081 x 400 = 32 μg/m^3

EPC_{WH1} = 15 x 32 = 480 μg/ℓ

EPC_{WH2} = 0.4 x 400 = 160 μg/ℓ

EPC_{LH} = 0.002 x 160 = 0.3 μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.8E4		32		
Water, $\mu g/l$ (ppm Wt)			2.7E5		160		
Land, $\mu g/g$ (ppm Wt)			5.4E2		0.3		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			32		
Water, $\mu g/l$ (ppm Wt)			160		
Land, $\mu g/g$ (ppm Wt)			0.3		

CATEGORY: 5C

WLN: QX

t-BUTANOL: $C_4H_{10}O$ (2-methyl-2-propanol, t-butyl alcohol). A colorless liquid, or rhombic prisms or planes; camphor-like odor.

STRUCTURE:

```
      CH3
       |
   CH3-C-CH3
       |
       OH
```

PROPERTIES:

Molecular wt: 74.12; mp: 25.3; bp: 82.8; d: 0.789; vap. press.: 40 mm at 24.5°; vap. d: 2.55; miscible in all proportions with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

t-Butanol has been identified in public water supply samples in concentration of 0.01 μg/ℓ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Butyl alcohols are not considered serious toxic hazards (ref. 9), but may be irritating to skin (ref. 23). Effects of long term continuous dosage were not injurous in animals tested (ref. 9).
LD_{50} (oral, rat): 3,500 mg/kg.
Aquatic toxicity: TLm 96: over 1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 300 mg/m^3 (100 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.00×10^5 μg/m^3 (100 ppm)
Water, Health: $15 \times 3.0 \times 10^5 = 4.5 \times 10^6$ μg/ℓ
Land, Health: $0.002 \times 4.5 \times 10^6 = 9 \times 10^3$ μg/g

Air, Ecology:
Water, Ecology: $100 \times >1,000 = >1.0 \times 10^5$ μg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^5 = 200$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 300/420 = 710$ μg/m^3
$EPC_{AH1a} = 100/420 = 0.24$ ppm
$EPC_{WH1} = 15 \times 710 - 10,700$ μg/ℓ
$EPC_{WH2} = 13.8 \times 300 = 4,140$ μg/ℓ
$EPC_{LH} = 0.002 \times 4,140 = 8.3$ μg/g

$EPC_{WE1} = 50 \times >1,000 = >50,000$ μg/ℓ
$EPC_{LE} = 0.002 \times 50,000 = 100$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m^3 (ppm Vol)			3.0E5 (100)		710 (0.24)		
Water, μg/l (ppm Wt)			4.5E6	>1.0E5	4,140	>50,000	0.01†
Land, μg/g (ppm Wt)			9.0E3	2.0E2	8.3	100	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m^3 (ppm Vol)			710 (0.24)		
Water, μg/l (ppm Wt)			4,140	>50,000	
Land, μg/g (ppm Wt)			8.3	100	

†Public water supply.

CATEGORY: 5C

WLN: QX2

t-PENTANOL: $C_5H_{12}O$ (t-pentyl alcohol t-amyl alcohol). (t indicates tertiary.)
Volatile liquid; characteristic odor, burning taste.

STRUCTURE:

```
       CH3
       |
CH3CH2-C-CH3
       |
       OH
```

2-Methyl-2-butanol

PROPERTIES:

Molecular wt: 88.15; bp: 102; mp: -8.4; vap. press.: 10 mm at 17.2°; vap. d: 3.03; d: 0.8059; soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Amyl alcohols are present in fusel oil.

TOXIC PROPERTIES, HEALTH EFFECTS:

No information related to the toxic effects of tertiary pentanol on humans is documented. Based on animal studies, the toxicity appears to be about three times that of the primary pentanols.

LD_{50} (oral, rat): 1,000 mg/kg.

Aquatic toxicity: TLm 96: over 1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 1{,}000 = 4.5 \times 10^4$ μg/m^3

Water, Health: $15 \times 4.5 \times 10^4 = 6.8 \times 10^5$ μg/ℓ

Land, Health: $0.002 \times 6.8 \times 10^5 = 1.4 \times 10^3$ μg/g

Air, Ecology:

Water, Ecology: $100 \times >1{,}000 = >1.0 \times 10^5$ μg/ℓ

Land, Ecology: $0.002 \times 1.0 \times 10^5 = 200$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 1{,}000 = 107$ μg/m^3

$EPC_{AH3} = 0.081 \times 1{,}000 = 81$ μg/m^3

$EPC_{WH1} = 15 \times 81 = 1{,}220$ μg/ℓ

$EPC_{WH2} = 13.8 \times 1{,}000 = 14{,}000$ μg/ℓ

$EPC_{LH} = 0.002 \times 14{,}000 = 28$ μg/g

$EPC_{WE1} = 50 \times >1{,}000 = >50{,}000$ μg/ℓ

$EPC_{LE} = 0.002 \times 50{,}000 = 100$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.5E4		81		
Water, $\mu g/l$ (ppm Wt)			6.8E5	>1.0E5	1,220	>50,000	
Land, $\mu g/g$ (ppm Wt)			1.4E3	2.0E2	28	100	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

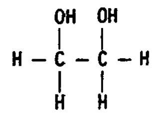
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			81		
Water, $\mu g/l$ (ppm Wt)			1,220	>50,000	
Land, $\mu g/g$ (ppm Wt)			28	100	

CATEGORY: 6A

WLN: Q2Q

ETHYLENE GLYCOL: $C_2H_6O_2$ (1,2-dihydroxyethane, 1,2-ethanediol). Ethylene glycol is an odorless, colorless, viscous, poisonous liquid with a sweet taste.

STRUCTURE:



PROPERTIES:

Molecular wt: 62.06; mp: -11.5; bp: 198; d: 1.1088; vap. press.: 13 mm at 93°; vap. d: 2.14; completely miscible with water; hygroscopic.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Ethylene glycol may be formed by the acid hydrolysis of ethylene oxide.

The low vapor pressure precludes exposure to vapors at room temperature (ref. 4).

TOXIC PROPERTIES, HEALTH EFFECTS:

Ingestion of 1,500 mg/kg has resulted in death for a human (ref. 2). When ingested, it causes central nervous system effects and kidney injury (ref. 9). Exposure to concentrations greater than 140 mg/m^3 is reported to cause irritation and other effects (ref. 4).

LD_{50} (oral, rat): 5,840 mg/kg.

Ethylene glycol appears in the NIOSH Suspected Carcinogens List. The ordering number is 3121. The lowest dosage to induce an oncogenic response is reported as 4 g/kg. The adjusted ordering number is 0.78.

Aquatic toxicity: TLm 96: 1,000-100 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 10 mg/m^3 (particulate).

TLV = 260 mg/m^3 (100 ppm) (vapor).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.0×10^4 µg/m^3

Water, Health: $15 \times 1.0 \times 10^4 = 1.5 \times 10^5$ µg/ℓ

Land, Health: $0.002 \times 1.5 \times 10^5 = 300$ µg/g

Air, Ecology:

Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ µg/ℓ

Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 10/420 = 24$ µg/m^3

$EPC_{WH1} = 15 \times 24 = 360$ µg/ℓ

$EPC_{WH2} = 13.8 \times 10 = 140$ µg/ℓ

$EPC_{LH} = 0.002 \times 140 = 0.3$ µg/g

$EPC_{WE1} = 50 \times 100 = 5,000$ µg/ℓ

$EPC_{LE} = 0.002 \times 5,000 = 10$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E4		24		
Water, $\mu g/l$ (ppm Wt)			1.5E5	1.0E4	140	5,000	
Land, $\mu g/g$ (ppm Wt)			3.0E2	2.0E1	0.3	10	

*To be multiplied by dilution factor

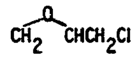
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			24		
Water, $\mu g/l$ (ppm Wt)			140	5,000	
Land, $\mu g/g$ (ppm Wt)			0.3	10	

CATEGORY: 6B

WLN: T3OTJ B1G

1-CHLORO-2,3-EPOXYPROPANE: C_3H_5ClO (epichlorohydrin).
A colorless, mobile liquid with an irritating, chloroform-like odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 92.53; bp: 117.9; mp: -25.6; d: 1.801;
vap. press.: 10 mm at 16.6; vap. d: 3.29; slightly soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The threshold for odor recognition is about 10 ppm (ref. 26). This is equivalent to approximately 40 mg/m^3.

TOXIC PROPERTIES, HEALTH EFFECTS:

Epichlorohydrin is irritating and toxic by inhalation, ingestion, or skin contact. Marked nose and eye irritation occur at levels over 100 ppm (ref. 26). As low as 20 ppm is reported to cause eye effects (ref. 2).

LD_{50} (oral, rat): 90 mg/kg.

LC_{Lo} (inhalation, rat): 250 ppm for 4 hours.

Epichlorohydrin is cumulative (ref. 4), and chronic exposure may cause kidney injury (ref. 24).

Epichlorohydrin appears in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3101. The lowest dose to induce an oncogenic response is reported as 720 mg/kg. The adjusted ordering number is 4.3.

Aquatic toxicity: TLm 96: 100-10 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 20 mg/m^3 (5 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/4.3 = 1.6 \times 10^4$ $\mu g/m^3$
Water, Health: $15 \times 1.6 \times 10^4 = 2.4 \times 10^5$ $\mu g/\ell$
Land, Health: $0.002 \times 2.4 \times 10^5 = 480$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 10 = 1.0 \times 10^3$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^3 = 2$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 20/420 = 48$ $\mu g/m^3$
$EPC_{AH1a} = 5/420 = 0.01$ ppm
$EPC_{WH1} = 15 \times 48 = 720$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 20 = 276$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 276 = 0.55$ $\mu g/g$
$EPC_{AC2} = 10^3/(6 \times 4.3) = 39$ $\mu g/m^3$
$EPC_{WC} = 15 \times 39 = 585$ $\mu g/\ell$
$EPC_{LC} = 0.002 \times 585 = 1.2$ $\mu g/g$

$EPC_{WE1} = 50 \times 10 = 500$ $\mu g/\ell$
$EPC_{LE} = 0.002 \times 500 = 1$ $\mu g/g$

1-CHLORO-2, 3-EPOXYPROPANE

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.6E4		39		
Water, μg/l (ppm Wt)			2.4E5	1.0E3	276	500	
Land, μg/g (ppm Wt)			4.8E2	2.0E0	0.55	1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			48 (0.01)		39
Water, μg/l (ppm Wt)			276	500	585
Land, μg/g (ppm Wt)			0.55	1	1.2

CATEGORY: 7A

WLN: VHH

FORMALDEHYDE: CH_2O (methanal, methyl aldehyde, methylene oxide).

A colorless gas with a pungent, suffocating odor.

STRUCTURE:

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H - C - H
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PROPERTIES:

Molecular wt.: 20.03; mp: -92; by: -21; d: 0.815; vap. d: 1.067; very soluble; vap. press.: 10 mm at -88°.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Formaldehyde is the simplest aldehyde. It is catalytically reduced to methanol or oxidized to formic acid. A 37-percent formaldehyde solution is called formalin.

There is some evidence that formaldehyde is a natural constituent of the atmosphere at a few parts per billion (ref. 27). Odor recognition level is 0.060 to 1.20 mg/m^3 (ref. 3). Photooxidation of formaldehyde is reported as 51 percent in 5 hours for an initial concentration of 15 ppm (ref. 3). Formaldehyde is emitted to the atmosphere in gasoline and diesel exhaust, from coal combustion, fuel-oil combustion, and from wood burning (ref. 27).

TOXIC PROPERTIES, HEALTH EFFECTS:

Formaldehyde is an irritant to eyes, mucous membranes, and respiratory tract. Eye irritation is experienced by some persons at concentrations of 0.1 ppm (ref. 27). Concentrations as low as 0.3 to 2.7 ppm cause irritatio in humans exemplified by annoying odor, prickling irritation of mucous membranes, and disturbed sleep (ref. 4). The lowest lethal oral dose to a human is 36 mg/kg (ref. 2).

LD_{50} (oral, rat): 800 mg/kg.

LC_{Lo} (inhalation, rat): 250 ppm for 4 hours.

Formaldehyde is included in the NIOSH Suspected Carcinogen List. The EPA/NIOSH ordering number is 4101; lowest dosage to produce an oncogenic response is 96 mg/kg; adjusted ordering number: 42.7.

Exposure to <0.2 ppm for two days caused plant leaf symptoms and necrosis in petunia (ref. 3). This is equivalent to 0.247 mg/m^3. A concentration of 95 mg/ℓ in water can cause tainting of fish flesh (ref. 28).

Aquatic toxicity: TLm 96 = 100-10 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 3 mg/m^3 (2 ppm).

On First Priority Chemicals List of the Chemical Industry Institute of Toxicology (ref. 8).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/42.7 = 1.6 \times 10^3$ $\mu g/m^3$

Water, Health: $15 \times 1.6 \times 10^3 = 2.4 \times 10^4$ μg/ℓ

Land, Health: $0.002 \times 2.4 \times 10^4 = 48$ μg/g

Air, Ecology: $247 \times 2 = 494$ $\mu g/m^3$

Water, Ecology: $100 \times 10 = 1.0 \times 10^3$ μg/ℓ

Land, Ecology: $0.002 \times 1.0 \times 10^3 = 2$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 3/420 = 7.14$ $\mu g/m^3$

$EPC_{AH1a} = 2/420 = 0.004$ ppm

$EPC_{WH1} = 15 \times 7.14 = 107.1$ μg/ℓ

$EPC_{WH2} = 13.8 \times 3 = 41.4$ μg/ℓ

$EPC_{LH} = 0.002 \times 41.4 = 0.08$ μg/g

$EPC_{AC2} = 10^3/(6 \times 42.7) = 3.9$ $\mu g/m^3$

$EPC_{WC} = 15 \times 3.9 = 58.5$ μg/ℓ

$EPC_{LC} = 0.002 \times 58.5 = 0.12$ μg/g

$EPC_{AE} = 100 \times 0.247 \times 2 = 49$ $\mu g/m^3$

$EPC_{WE1} = 50 \times 10 = 500$ μg/ℓ

$EPC_{WE2} = 95,000$ μg/ℓ (to prevent tainting)

$EPC_{LE} = 0.002 \times 500 = 1$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.6E3	5.0E2	3.9	49	~3
Water, $\mu g/l$ (ppm Wt)			2.4E4	1.0E3	41.4	500	
Land, $\mu g/g$ (ppm Wt)			4.8E1	2.0E0	0.08	1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			7.14 (0.004)	49	3.9
Water, $\mu g/l$ (ppm Wt)			41.4	500	58.5
Land, $\mu g/g$ (ppm Wt)			0.08	1	0.12

CATEGORY: 7A

WLN: VH1

ACETALDEHYDE: C_2H_4O (acetic aldehyde, ethanal, ethyl aldehyde). A colorless, fuming liquid; pungent, fruity odor.

STRUCTURE:

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H-C-CH3
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PROPERTIES:

Molecular wt.: 44.05; mp: -121; bp: 20.8; d: 0.780-0.790 g/ml; vap. press.: 760 mm at 20.2°; vap. d: 1.52; soluble in all proportions in hot water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Aldehydes can be catalytically reduced to alcohols.

Rural concentration in air is reported as 0.3 ppb (ref. 1). This is equivalent to 0.0003 ppm or 0.530 $\mu g/m^3$. Odor recognition range is 130 to 412 $\mu g/m^3$ (ref. 3). Photooxidation of acetaldehyde is reported as 12 percent in five hours for initial concentration of 5 ppm (ref. 3).

Acetaldehyde has been found in samples of public drinking water supplies at concentrations of 0.1 $\mu g/\ell$ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Acetaldehyde is an eye and respiratory system irritant and a central nervous system narcotic (refs. 4,9).

The ACGIH TLV is substantially higher than the USSR limit of 3 ppm (ref. 4). A concentration of 50 ppm causes irritative effects in humans (ref. 4).

LD_{50} (oral, rat): 1,930 mg/kg.

LC_{Lo} (inhalation, rat): 4,000 ppm for 4 hours.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 180 mg/m^3 (100 ppm). (Recommended to prevent excessive eye irritation and potential injury to the respiratory tract.)

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.8×10^5 $\mu g/m^3$ (100 ppm)
Water, Health: $15 \times 1.8 \times 10^5 = 2.7 \times 10^6$ $\mu g/\ell$
Land, Health: $0.002 \times 2.7 \times 10^6 = 5.4 \times 10^3$ $\mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 180/420 = 430$ $\mu g/m^3$
$EPC_{AH1a} = 100/420 = 0.24$ ppm
$EPC_{WH1} = 15 \times 430 = 6{,}450$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 180 = 2{,}480$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 2{,}480 = 5$ $\mu g/g$

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.8E5 (100)		430 (0.24)		0.53
Water, µg/l (ppm Wt)			2.7E6		2,480		0.1†
Land, µg/g (ppm Wt)			5.4E3		5		

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			430 (0.24)		
Water, µg/l (ppm Wt)			2,480		
Land, µg/g (ppm Wt)			5		

†Public drinking water supplies.

CATEGORY: 7A

WLN: VH1U1

ACROLEIN: C_3H_4O (acrylic aldehyde, propenal).
A colorless or yellowish liquid; disagreeable choking odor.

STRUCTURE:

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H-C-C=CH2
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PROPERTIES:

Molecular wt: 56.06; bp: 52.5; mp: -87; vap. press.: 214 mm at 20°; vap. d: 1.94; d: .8389; very soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

An urban concentration of 0.003 ppm has been reported (ref. 1). This is equivalent to 6.9 $\mu g/m^3$. Odor recognition levels ranging from 480 to 4,500 $\mu g/m^3$ are reported (refs. 3, 29).

TOXIC PROPERTIES, HEALTH EFFECTS:

Acrolein, because of its unsaturation, is much more toxic and irritating than the saturated aldehydes. It causes respiratory irritation in concentrations as low as 1 ppm (ref. 2). The lowest reported lethal concentration of acrolein for man is 153 ppm for 10 minutes (ref. 2). The compound causes lacrimation at 0.67 ppm after 20 seconds (ref. 27).

LD_{50} (oral, rat): 46 mg/kg.

LC_{Lo} (inhalation, rat): 8 ppm for 4 hours.

Aquatic toxicity: TLm 96: <1 ppm (ref. 2).

Toxicity to vegetation: Alfalfa sustained oxidant type damage when exposed to 250 $\mu g/m^3$ (0.1 ppm) for 9 hours (ref. 30).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.25 mg/m^3 (0.1 ppm).

Acrolein appears on EPA Consent Decree Priority III List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 250 $\mu g/m^3$ (0.1 ppm)
Water, Health: $15 \times 250 = 3.75 \times 10^3$ $\mu g/\ell$
Land, Health: $0.002 \times 3.75 \times 10^3 = 7.5$ $\mu g/g$

Air, Ecology: $250 \times 9/24 = 94$ $\mu g/m^3$
Water, Ecology: $100 \times <1 = <100$ $\mu g/\ell$
Land, Ecology: $0.002 \times 100 = 0.2$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.25/420 = 0.6$ $\mu g/m^3$
$EPC_{AH1a} = 0.1/420 = 0.00024$ ppm
$EPC_{WH1} = 15 \times 0.6 = 9$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 0.25 = 3.5$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 3.5 = 0.007$ $\mu g/g$

$EPC_{AE} = 0.1 \times 250 \times 9/24 = 9$ $\mu g/m^3$
$EPC_{WE1} = 50 \times <1 = <50$ $\mu g/\ell$
$EPC_{LE} = 0.002 \times 50 = 0.1$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			2.5E2 (0.1)	9.4E1	0.6 (2.4E-4)	9	6.9†
Water, μg/l (ppm Wt)			3.75E3	<1.0E2	3.5	<50	
Land, μg/g (ppm Wt)			7.5E0	2.0E-1	0.007	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			0.6 (2.4E-4)	9	
Water, μg/l (ppm Wt)			3.5	<50	
Land, μg/g (ppm Wt)			0.007	0.1	

†Concentration is reported for urban atmosphere. No rural concentration is reported.

CATEGORY: 7A

WLN: VH2

PROPIONALDEHYDE: C_3H_6O (propanal, propaldehyde, propyl aldehyde). A colorless liquid; suffocating odor.

STRUCTURE:

$$H-\overset{\overset{O}{\|}}{C}-C_2H_5$$

PROPERTIES:

Molecular wt: 58.1; bp: 48; mp: -81; d: 0.807;
vap. d: 2.0; vap. press.: 300 mm at 25°; soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Rural background concentration in air is reported to be 0.5 to 3.8 ppbc (ref. 1). This is equivalent to 0.16-1.27 ppb or 0.38-3.01 $\mu g/m^3$.

Photooxidation of propionaldehyde is reported as 25 percent in 6 hours for an initial concentration of 19 ppm (ref. 3).

TOXIC PROPERTIES, HEALTH EFFECTS:

The acute toxic properties of propionaldehyde are similar to other small aldehydes. It is a local irritant to eyes and mucous membranes and acts as a central nervous system narcotic.

LD_{Lo} (oral, rat): 800 mg/kg
LC_{Lo} (inhalation, rat): 8,000 ppm for 4 hours.
Aquatic toxicity: TLm 96: 1,000-100 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 800 = 3.6 \times 10^4$ $\mu g/m^3$
Water, Health: $15 \times 3.6 \times 10^4 = 5.4 \times 10^5$ $\mu g/\ell$
Land, Health: $0.002 \times 5.4 \times 10^5 = 1.1 \times 10^3$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 800 = 86$ $\mu g/m^3$
$EPC_{AH3} = 0.081 \times 800 = 65$ $\mu g/m^3$
$EPC_{WH1} = 15 \times 65 = 980$ $\mu g/\ell$
$EPC_{WH2} = 0.4 \times 800 = 320$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 320 = 0.6$ $\mu g/g$

$EPC_{WE1} = 50 \times 100 = 5,000$ $\mu g/\ell$

$EPC_{LE} = 0.002 \times 5,000 = 10$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			3.6E4		65		0.38 to 3.01
Water, μg/l (ppm Wt)			5.4E5	1.0E4	320	5,000	
Land, μg/g (ppm Wt)			1.1E3	2.0E1	0.6	10	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			65		
Water, μg/l (ppm Wt)			320	5,000	
Land, μg/g (ppm Wt)			0.6	10	

CATEGORY: 7A

WLN: VH3

BUTYRALDEHYDE: C_4H_8O (butanal, butric aldehyde, n-butyl aldehyde). A colorless, flammable, liquid.

STRUCTURE:

$$CH_3CH_2CH_2\overset{H}{C}=O$$

PROPERTIES:

Molecular wt: 72.1; mp: -100° C; bp: 74.7° C; d: 0.802_4^{20}; vap. d: 2.5; miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

TOXIC PROPERTIES, HEALTH EFFECTS:

A concentration of 580 mg/m^3 is reported to cause irritative effects in humans (ref. 2).
LD_{50} (oral, rat): 2,490 mg/kg.
Aquatic toxicity: TLm 96: 10-1 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 2{,}490 = 1.1 \times 10^5\ \mu g/m^3$
Water, Health: $15 \times 1.1 \times 10^5 = 1.65 \times 10^6\ \mu g/\ell$
Land, Health: $0.002 \times 1.65 \times 10^6 = 3.3 \times 10^3\ \mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 1 = 100\ \mu g/\ell$
Land, Ecology: $0.002 \times 100 = 0.2\ \mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 2{,}490 = 266\ \mu g/m^3$
$EPC_{AH3} = 0.081 \times 2{,}490 = 202\ \mu g/m^3$
$EPC_{WH1} = 15 \times 202 = 3{,}030\ \mu g/\ell$
$EPC_{WH2} = 0.4 \times 2{,}490 = 1{,}000\ \mu g/\ell$
$EPC_{LH} = 0.002 \times 1{,}000 = 2\ \mu g/g$

$EPC_{WE1} = 50 \times 1 = 50\ \mu g/\ell$
$EPC_{LE} = 0.002 \times 50 = 0.1\ \mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.1E5		202		
Water, $\mu g/l$ (ppm Wt)			1.65E6	1.0E2	1,000	50	
Land, $\mu g/g$ (ppm Wt)			3.3E3	2.0E-1	2	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			202		
Water, $\mu g/l$ (ppm Wt)			1,000	50	
Land, $\mu g/g$ (ppm Wt)			2	0.1	

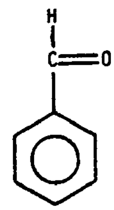
CATEGORY: 7A

WLN: VHR

BENZALDEHYDE: C_7H_6O (phenylaldehyde, benzenecarbinal, benzoic aldehyde).

A colorless liquid; bitter almond odor.

STRUCTURE.



PROPERTIES:

Molecular wt: 106.09; mp: -26; bp: 178.1; d: 1.043^{25}; vap. d: 3.65; vap. press.: 1 mm at 26.2°; sparingly soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Occurs in kernels of bitter almonds (ref. 24). Used as synthetic flavoring substance (ref. 9).

TOXIC PROPERTIES, HEALTH EFFECTS:

Benzaldehyde acts as a weak local anesthetic. It is narcotic in high concentrations and may cause dermatitis (ref. 24).

LD_{50} (oral, rat): 1,300 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 45 x 1,300 = 5.85×10^4 µg/m^3

Water, Health: 15 x 5.85×10^4 = 8.8×10^5 µg/ℓ

Land, Health: 0.002 x 8.8×10^5 = 1.8×10^3 µg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH2} = 0.107 x 1,300 = 140 µg/m^3

EPC_{AH3} = 0.081 x 1,300 = 105 µg/m^3

EPC_{WH1} = 15 x 105 = 1,580 µg/ℓ

EPC_{WH2} = 0.4 x 1,300 = 520 µg/ℓ

EPC_{LH} = 0.002 x 520 = 1 µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.85E4		105		
Water, $\mu g/l$ (ppm Wt)			8.8E5		520		
Land, $\mu g/g$ (ppm Wt)			1.8E3		1		

*To be multiplied by dilution factor

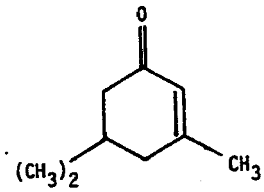
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			105		
Water, $\mu g/l$ (ppm Wt)			520		
Land, $\mu g/g$ (ppm Wt)			1		

CATEGORY: 7B

WLN: L6V BUTJ C D D

ISOPHORONE: $C_9H_{14}O$ (isoacetophorone, 3,5,5-trimethyl-2-cyclohexene-1 one).
A water-white liquid; peppermint odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 138.09; bp: 215.2; mp: -8.1; d: 0.9229;
vap. press.: .44 mm at 25°; vap. d: 4.77; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Due to its low volatility, isophorone is not a dangerous industrial hazard (ref. 31). Concentrations of 9.5 µg/ℓ of isophorone have been found in samples from public drinking water supplies (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Isophorone is one of the most toxic of the ketones. It is an irritant at 25 ppm or 141 mg/m^3. In high concentrations, isophorone is a kidney poison (ref. 9). Concentrations of 5-8 ppm for a month are reported to cause fatigue and malaise (ref. 4).

LD_{50} (oral, rat): 2,330 mg/kg.
LD_{Lo} (inhalation, rat): 1,840 ppm for 4 hours

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV: 25 mg/m^3 (5 ppm).
On EPA Consent Decree Priority III List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2.5×10^4 µg/m^3 (5 ppm)
Water, Health: $15 \times 2.5 \times 10^4 = 3.75 \times 10^5$ µg/ℓ
Land, Health: $0.002 \times 3.75 \times 10^5 = 750$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 25/420 = 60$ µg/m^3
$EPC_{AH1a} = 5/420 = 0.01$ ppm
$EPC_{WH1} = 15 \times 60 = 900$ µg/ℓ
$EPC_{WH2} = 13.8 \times 25 = 345$ µg/ℓ
$EPC_{LH} = 0.002 \times 345 = 0.7$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			2.5E4		60 (0.01)		
Water, μg/l (ppm Wt)			3.75E5		345		9.5†
Land, μg/g (ppm Wt)			7.5E2		0.7		

*To be multiplied by dilution factor

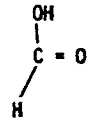
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			60 (0.01)		
Water, μg/l (ppm Wt)			345		
Land, μg/g (ppm Wt)			0.7		

†Public drinking water supplies.

CATEGORY: 8A

WLN: VHQ

STRUCTURE:



FORMIC ACID: CH_2O_2 (methanoic acid).
A colorless, fuming liquid; pungent odor.

PROPERTIES:

Molecular wt: 46.03; mp: 8.4; bp: 100.7; d: 1.220;
vap. d: 1.59; vap. press.: 43 mm at 25°; miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Formic acid is the first in the aliphatic series of carboxylic acids. It is a strong reducing agent and is more highly dissociated in water than is acetic acid.

TOXIC PROPERTIES, HEALTH EFFECTS:

Formic acid acts as an irritant to mucous membranes, eyes, and skin. Workers exposed to 15 ppm complained of nausea (ref. 4). Chronic absorption may cause albuminuria and hematuria (ref. 24).

LD_{50} (oral, rat): 1,210 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 9 mg/m^3 (5 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 9×10^3 µg/m^3 (5 ppm)
Water, Health: $15 \times 9 \times 10^3 = 1.4 \times 10^5$ µg/ℓ
Land, Health: $0.002 \times 1.4 \times 10^5 = 280$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 9/420 = 21$ µg/m^3
$EPC_{AH1a} = 5/420 = 0.01$ ppm
$EPC_{WH1} = 15 \times 21 = 315$ µg/ℓ
$EPC_{WH2} = 13.8 \times 9 = 124$ µg/ℓ
$EPC_{LH} = 0.002 \times 124 = 0.25$ µg/g

MULTIMEDIA ENVIRONMENTAL GOALS

8A FORMIC ACID

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			9.0E3 (5)		21 (0.01)		
Water, μg/l (ppm Wt)			1.4E5		124		
Land, μg/g (ppm Wt)			2.8E2		0.25		

*To be multiplied by dilution factor

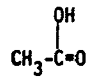
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			21 (0.01)		
Water, μg/l (ppm Wt)			124		
Land, μg/g (ppm Wt)			0.25		

CATEGORY: 8A

WLN: QV1

ACETIC ACID: CH_3CO_2H (ethanoic acid).
A clear, colorless liquid; pungent odor.

STRUCTURE.



PROPERTIES:

Molecular wt: 60.05; mp: 16.6; bp: 118.1;
d: 1.049; vap. press.: 11.4 mm at 20°; vap. d: 2.07;
miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Organic acids are emitted to the atmosphere in large quantities from coal-fired boilers. An average of 12.4 lb of organic acid (as acetic acid) per ton of coal burned is reported for one large plant (ref. 27).

Acetic acid is formed by the air oxidation of acetaldehyde. Bacterial oxidation of ethyl alcohol also results in formation of acetic acid.

The concentration of acetic acid in rural atmosphere is reported as 1.0 ppm (ref. 1). This is equivalent to 2.45 mg/m^3. (This value is representative of an agricultural area and is not indicative of a natural background concentration.) The odor recognition level is reported as 2.7 mg/m^3 (ref. 3).

High concentrations of organic acids in water cause a lowering of the pH.

TOXIC PROPERTIES, HEALTH EFFECTS:

Vapors of acetic acid may cause irritation of mucous membranes, lacrimation, conjunctivitis, and dermatitis (ref. 9). Irritative effects are produced in humans by 816 ppm for 3 minutes (ref. 2). Conjunctival irritation has occurred at 10 ppm (ref. 4).

LD_{50} (oral, rat): 3,310 mg/kg.

LC_{50} (inhalation, mouse): 5,620 ppm for 1 hour.

Aquatic toxicity: TLm 96: 100-10 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 25 mg/m^3 (10 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2.5×10^4 $\mu g/m^3$ (10 ppm)
Water, Health: $15 \times 2.5 \times 10^4 = 3.8 \times 10^5$ $\mu g/\ell$
Land, Health: $0.002 \times 3.8 \times 10^5 = 760$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 10 = 1.0 \times 10^3$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^3 = 2$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 25/420 = 60$ $\mu g/m^3$
$EPC_{AH1a} = 10/420 = 0.02$ ppm
$EPC_{WH1} = 15 \times 60 = 900$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 25 = 345$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 345 = 0.7$ $\mu g/g$

$EPC_{WE1} = 50 \times 10 = 500$ $\mu g/\ell$
$EPC_{LE} = 0.002 \times 500 = 1$ $\mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.5E4		60 (0.02)		
Water, $\mu g/l$ (ppm Wt)			3.8E5	1.0E3	345	500	
Land, $\mu g/g$ (ppm Wt)			7.6E2	2.0E0	0.7	1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

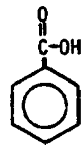
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			60 (0.02)		
Water, $\mu g/l$ (ppm Wt)			345	500	
Land, $\mu g/g$ (ppm Wt)			0.7	1	

CATEGORY: 8A

WLN: QVR

BENZOIC ACID: C_6H_5COOH (benzenecarboxylic acid, phenyl formic acid).
White needles or powder.

STRUCTURE:



PROPERTIES:

Molecular wt: 122.13; bp: 249.2; mp: 122.4; begins to sublime at around 100°; volatile with steam; solubility: 0.34 g/100 g; soluble in hot water; vap. press.: 1 mm at 96°; vap. d: 4.21.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Benzoic acid may be formed by the air oxidation (in presence of catalyst) of toluene.

It occurs in nature in both free and combined states. Most berries contain benzoic acid--0.05 percent (ref. 24).

In water, benzoic acid is more highly dissociated than acetic acid but less than formic acid.

It is used in preserving foods and in curing tobacco (ref. 24). Concentrations of 15 μg/ℓ have been found in samples of public drinking water supplies (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Benzoic acid is an irritant to eyes, skin, and mucous membranes (ref. 24). 6 mg/kg applied to human skin has resulted in a toxic response (ref. 2). Severe toxic effects have not been reported.

LD_{50}(oral, rat): 3,040 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 3{,}040 = 1.4 \times 10^5$ μg/m^3

Water, Health: $15 \times 1.4 \times 10^5 = 2.1 \times 10^6$ μg/ℓ

Land, Health: $0.002 \times 2.1 \times 10^6 = 4.2 \times 10^3$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 3{,}040 = 325$ μg/m^3

$EPC_{AH3} = 0.081 \times 3{,}040 = 246$ μg/m^3

$EPC_{WH1} = 15 \times 246 = 3{,}700$ μg/ℓ

$EPC_{WH2} = 0.4 \times 3{,}040 = 1{,}220$ μg/ℓ

$EPC_{LH} = 0.002 \times 1{,}220 = 2.4$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m^3 (ppm Vol)			1.4E5		246		
Water, μg/l (ppm Wt)			2.1E6		1,220		15†
Land, μg/g (ppm Wt)			4.2E3		2.4		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m^3 (ppm Vol)			246		
Water, μg/l (ppm Wt)			1,220		
Land, μg/g (ppm Wt)			2.4		

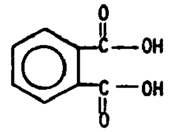
†Public drinking water supplies.

CATEGORY: 8A

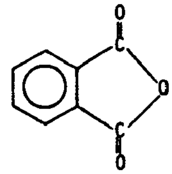
WLN: QVR BVQ

PHTHALIC ACID: $C_8H_6O_4$ (1,2-benzenedicarboxylic acid, o-phthalic acid).
Colorless crystals.

STRUCTURE:



Phthalic acid



Phthalic anhydride

PROPERTIES:

Molecular wt: 166.14; mp: 210-211 (decomposes, sublimes); d: 1.593; solubility: 0.7 g/100 g; very soluble in hot water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Phthalic acid is an aromatic dicarboxylic acid. Both carboxylic acid functions may react to form salts, esters, amide, or anhydride. The anhydride reacts with water, reforming the phthalic acid. In water, one carboxylic acid function is ionized to a greater extent than is acetic acid, formic acid, or benzoic acid; ionization of the second carboxylic acid function occurs less readily.

Phthalic acid may be formed by the hydrolysis of benzene-1,2-dinitrile or by oxidation of 1,2-dimethyl benzene.

TOXIC PROPERTIES, HEALTH EFFECTS:

Phthalic acid acts as an irritant to skin, eye, and upper respiratory system.

LD_{Lo} (oral, rat): 4,600 mg/kg.

Teratogenic effects due to phthalic acid are reported. A 4 percent incidence of congenital defects resulted in chicks receiving 3 to 20 mg via the yolk sac or air cell before incubation (ref. 32). The EPA/NIOSH ordering number based on this data is 1101. It is not possible to extrapolate to mg/kg the dosage administered directly to the egg yolk sac of a chick, so adjusted ordering number cannot be determined from this data.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (phthalic anhydride): 6 mg/m^3 (1 ppm).
(Phthalic acid is formed by the reaction of phthalic anhydride and water.)

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 6.0×10^3 $\mu g/m^3$ (1 ppm)	Air, Ecology:
Water, Health: $15 \times 6.0 \times 10^3 = 9.0 \times 10^4$ $\mu g/\ell$	Water, Ecology:
Land, Health: $0.002 \times 9.0 \times 10^4 = 180$ $\mu g/g$	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 6/420 = 14\ \mu g/m^3$
$EPC_{AH1a} = 1/420 = 0.002$ ppm
$EPC_{WH1} = 15 \times 14 = 210\ \mu g/\ell$
$EPC_{WH2} = 13.8 \times 6 = 83\ \mu g/\ell$
$EPC_{LH} = 0.002 \times 83 = 0.2\ \mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			6.0E3 (1)		14 (0.002)		
Water, $\mu g/l$ (ppm Wt)			9.0E4		83		
Land, $\mu g/g$ (ppm Wt)			1.8E2		0.2		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

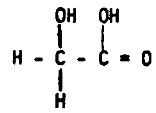
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			14 (0.002)		
Water, $\mu g/l$ (ppm Wt)			83		
Land, $\mu g/g$ (ppm Wt)			0.2		

CATEGORY: 8B

WLN: QV1Q

HYDROXYACETIC ACID: $C_2H_4O_3$ (glycolic acid, hydroxyethanoic acid).
Colorless, odorless, somewhat hygroscopic leaflets.

STRUCTURE:



PROPERTIES:

Molecular wt: 76.05; mp: 80° (decomposes); soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Hydroxyacetic acid is an α-hydroxy acid. In water, it is more highly dissociated than acetic acid. It is found in sugarcane juice (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

Hydroxyacetic acid is more toxic than acetic acid. It is primarily an irritant to mucous membranes.

LD_{50} (oral, rat): 1,950 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 1{,}950 = 8.8 \times 10^4$ μg/m³

Water, Health: $15 \times 8.8 \times 10^4 = 1.3 \times 10^6$ μg/ℓ

Land, Health: $0.002 \times 1.3 \times 10^6 = 2.6 \times 10^3$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 1{,}950 = 209$ μg/m³

$EPC_{AH3} = 0.081 \times 1{,}950 = 158$ μg/m³

$EPC_{WH1} = 15 \times 158 = 2{,}370$ μg/ℓ

$EPC_{WH2} = 0.4 \times 1{,}950 = 780$ μg/ℓ

$EPC_{LH} = 0.002 \times 780 = 1.6$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			8.8E4		158		
Water, $\mu g/l$ (ppm Wt)			1.3E6		780		
Land, $\mu g/g$ (ppm Wt)			2.6E3		1.6		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			158		
Water, $\mu g/l$ (ppm Wt)			780		
Land, $\mu g/g$ (ppm Wt)			1.6		

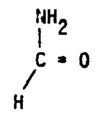
CATEGORY: 8C

WLN: ZVH

FORMAMIDE: $HCONH_2$ (formic acid amide, formylamine, methanamide).

A colorless, hygroscopic, viscous, oily liquid.

STRUCTURE:



PROPERTIES:

Molecular wt: 45.04; mp: 2.55; bp: 210.7; decomposes; d: 1.1334^{20}_{4}; vap. press.: 29.7 mm at 129.4°; miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Formamide is a derivative of formic acid and in water hydrolyzes to form the parent acid. Formamide is obtained by heating ammonium formate in the presence of ammonia. At its boiling point, it decomposes to ammonia and carbon monoxide.

TOXIC PROPERTIES, HEALTH EFFECTS:

Animal experiments have indicated that repeated exposure to formamide results in cumulative effects, although toxicity by all routes is low.

Formamide is not reported to have presented any serious toxicologic hazards in industrial use (ref. 4). It is considered considerably less acutely toxic than dimethyl formamide.

LD_{50} (oral, rat): 7,500 mg/kg.

Formamide has caused teratogenic effects when 6 g/kg were administered to pregnant rats. The EPA/NIOSH ordering number is 4101, and the adjusted ordering number is 0.7.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 30 mg/m^3 (20 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.0×10^4 μg/m^3 (20 ppm)

Water, Health: $15 \times 3.0 \times 10^4 = 4.5 \times 10^5$ μg/ℓ

Land, Health: $0.002 \times 4.5 \times 10^5 = 900$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 30/420 = 71$ μg/m^3

$EPC_{AH1a} = 20/420 = 0.05$ ppm

$EPC_{WH1} = 15 \times 71 = 1,070$ μg/ℓ

$EPC_{WH2} = 13.8 \times 30 = 414$ μg/ℓ

$EPC_{LH} = 0.002 \times 414 = 0.8$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			3.0E4 (20)		71 (0.05)		
Water, μg/l (ppm Wt)			4.5E5		414		
Land, μg/g (ppm Wt)			9.0E2		0.8		

*To be multiplied by dilution factor

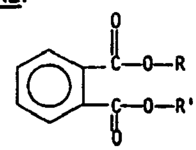
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			71 (0.05)		
Water, μg/l (ppm Wt)			414		
Land, μg/g (ppm Wt)			0.8		

CATEGORY: 8D

WLN: 1OVR BVO1; 2OVR BVO2; 4OVR BVO4

PHTHALATE ESTERS: (including dimethyl phthalate, $C_{10}H_{10}O_4$; diethyl phthalate, $C_{12}H_{14}O_4$; and di-n-butyl phthalate, $C_{16}H_{22}O_4$).
Colorless, oily liquids.

STRUCTURE:



(where R and R' are alkyl groups)

PROPERTIES:

	molecular wt	bp	mp	d	vap. d	vap. press.	solubility in water
o-Dimethyl phthalate	194.19	238.8	5.5	1.1905^{20}_{4}	6.69	1 mm at 100.3°	0.43 g/100 ml
Diethyl-o-phthalate	222.24	29.5	-40.5	1.1175^{20}_{4}	7.66	1 mm at 108.8°	insoluble
Di-n-butyl-m-phthalate	278.35	340		1.047^{20}_{20}	9.58	1 mm at 148.2°	1:2,500

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The phthalate esters are dialkyl esters of phthalic acid and are commonly used as insect repellants. Diethyl phthalate has been found in samples from public drinking water supplies in concentrations of 1.0 μg/ℓ; dimethyl phthalate, 0.82 μg/ℓ; and dibutyl phthalate, 5.0 μg/ℓ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

The phthalate esters are not considered highly toxic. Exposure via skin has been widely tested because of use as an insect repellant, and has rarely caused difficulties. They are somewhat irritating to the eyes and nose. Accumulation of phthalate esters in humans is not reported. Ingestion by a human of 140 mg/kg of dibutyl phthalate resulted in temporary effects to the central nervous system (refs. 4, 2); ingestion of 143 mg/kg of bis(2-ethylhexyl) phthalate and dioctyl phthalate caused gastrointestinal tract effects (ref. 2).

Teratogenic effects have been caused in rats by dibutyl phthalate (TD_{Lo}: 874 mg/kg), diethyl phthalate (TD_{Lo}: 1,232 mg/kg), dimethyl phthalate (TD_{Lo}: 1,014 mg/kg), and several other phthalate esters (ref. 2).
The EPA/NIOSH ordering number for the phthalate, considered collectively based on teratogenic potential, is 4101. The adjusted ordering number using the lowest dosage reported for teratogenic effects from dibutyl phthalate is 4.7.

Aquatic toxicity: Even though acute toxicity is of a low degree, phthalate esters are accumulated by certain aquatic species, and reproductive impairment sometimes occurs (ref. 33,34). TLm 96 for dibutyl phthalate: 1,000-100 ppm; for benzyl butyl phthalate, over 1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 5 mg/m^3 (for dimethyl phthalate, dibutyl phthalate, diethyl phthalate). (The TLV is recommended to control the mist from the phthalates, since they are often sprayed.)

EPA 1976 water quality criteria (proposed): 3 μg/ℓ for freshwater aquatic life (ref. 33).

NAS/NAE 1972 recommended water quality criteria: 0.3 μg/ℓ to protect fish and their food supply (ref. 28).

Phthalate esters are included on the EPA Consent Decree Priority II List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 5×10^3 μg/m^3
Water, Health: $15 \times 5 \times 10^3 = 7.5 \times 10^4$ μg/ℓ
Land, Health: $0.002 \times 7.5 \times 10^4 = 150$ μg/g

Air, Ecology:
Water, Ecology: $5 \times 0.3 = 1.5$ μg/ℓ
Land, Ecology: $0.002 \times 1.5 = 0.003$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 5/420 = 12$ μg/m^3
$EPC_{WH1} = 15 \times 12 = 180$ μg/ℓ
$EPC_{WH2} = 13.8 \times 5 = 69$ μg/ℓ
$EPC_{LH} = 0.002 \times 69 = 0.14$ μg/g

$EPC_{WE1} = 50 \times 100 = 5{,}000$ μg/ℓ
$EPC_{WES} = 0.3$ μg/ℓ
$EPC_{LE} = 0.002 \times 0.3 = 0.0006$ μg/g
$EPC_{AT} = 10^3/(6 \times 4.3) = 39$ μg/m^3
$EPC_{WT} = 15 \times 39 = 585$ μg/ℓ
$EPC_{LT} = 0.002 \times 585 = 1.2$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			5.0E3		12		
Water, μg/l (ppm Wt)			7.5E4	1.5	69	0.3	0.82 to 5†
Land, μg/g (ppm Wt)			1.5E2	3.0E-3	0.14	0.0006	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			12		39
Water, μg/l (ppm Wt)		0.3	69		585
Land, μg/g (ppm Wt)			0.14	0.0006	1.2

†Public drinking water supplies.

CATEGORY: 9 WLN: NC1

ACETONITRILE: CH_3CN (methyl cyanide).
A colorless liquid with an odor similar to ether.

STRUCTURE:

CH_3CN

PROPERTIES:

Molecular wt: 41.03; mp: -41; bp: 81.6; d: 0.783^{25}_{25};
vap. press.: 100 mm at 27°; vap. d: 1.42; miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Acetonitrile is decomposed by heat. The odor is reported to be detectable at 40 ppm or 70 mg/m^3 (ref. 4).

TOXIC PROPERTIES, HEALTH EFFECTS:

Human death has resulted from exposure to high concentrations of acetonitrile. Bronchial effects have resulted from exposure to 160 ppm. Exposure to concentrations below 40 ppm is not expected to cause organic cyanide poisoning or injury to the respiratory tract (ref. 4).

Animal studies show that different species and individuals vary widely in susceptibility to acetonitrile (ref. 4).

LD_{50} (oral, rat): 3,800 mg/kg
LC_{Lo} (inhalation, rat): 8,000 ppm for 4 hours.
Aquatic toxicity: TLm 96: 1,000 ppm

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 70 mg/m^3 (40 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 7.0×10^4 $\mu g/m^3$ (40 ppm)
Water, Health: $15 \times 7.0 \times 10^4 = 1.05 \times 10^6$ $\mu g/l$
Land, Health: $0.002 \times 1.05 \times 10^6 = 2.1 \times 10^3$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 1{,}000 = 1.0 \times 10^5$ $\mu g/l$
Land, Ecology: $0.002 \times 1.0 \times 10^5 = 200$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 70/420 = 167$ $\mu g/m^3$
$EPC_{AH1a} = 40/420 = 0.1$ ppm
$EPC_{WH1} = 15 \times 167 = 2{,}500$ $\mu g/l$
$EPC_{WH2} = 13.8 \times 70 = 970$ $\mu g/l$
$EPC_{LH} = 0.002 \times 970 = 2$ $\mu g/g$

$EPC_{WE1} = 50 \times 1{,}000 = 50{,}000$ $\mu g/l$
$EPC_{LE} = 0.002 \times 50{,}000 = 100$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, µg/m³ (ppm Vol)			7.0E4 (40)		167 (0.1)		
Water, µg/l (ppm Wt)			1.05E6	1.0E5	970	50,000	
Land, µg/g (ppm Wt)			2.1E3	2.0E2	2	100	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, µg/m³ (ppm Vol)			167 (0.1)		
Water, µg/l (ppm Wt)			970	50,000	
Land, µg/g (ppm Wt)			2	100	

CATEGORY: 9

WLN: NC1U1

ACRYLONITRILE: C_3H_3N (cyanoethylene, vinyl cyanide, acrylon). An explosive, flammable liquid with a penetrating odor.

STRUCTURE:

$CH_2 = CHCN$

PROPERTIES:

Molecular wt: 53.04; mp: -82; bp: 78.5; d: 0.8060;
vap. press.: 200 mm at 38.7; 100 mm at 22.8°; vap. d: 1.83; slightly soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The odor threshold level for acrylonitrile is reported as 21.4 ppm (ref. 29). Acrylonitrile can be formed by the reaction of acetylene with hydrogen cyanide.

TOXIC PROPERTIES, HEALTH EFFECTS:

Vapors of acrylonitrile are extremely toxic and inhibit respiratory enzymes in cells. It is absorbed through the skin with possible formation of cyanide in the tissues (ref. 35). There is little evidence of cumulative action on repeated exposure (ref. 9).

LD_{50} (oral, rat): 82 mg/kg.
LC_{Lo} (inhalation, rat): 500 ppm for 4 hours.
Aquatic toxicity: TLm 96: 100-10 ppm (ref. 2).

A concentration of 18 mg/ℓ of acrylonitrile in water is reported to cause tainting of fish flesh (ref. 36).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Acrylonitrile is on EPA Consent Decree Priority III List.
TLV = 45 mg/m^3 (20 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 4.5×10^4 μg/m^3 (20 ppm)
Water, Health: $15 \times 4.5 \times 10^4 = 6.75 \times 10^5$ μg/ℓ
Land, Health: $0.002 \times 6.75 \times 10^5 = 1.4 \times 10^3$ μg/g

Air, Ecology:
Water, Ecology: $100 \times 10 = 1.0 \times 10^4$ μg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^4 = 2$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 45/420 = 107$ μg/m^3
$EPC_{AH1a} = 20/420 = 0.05$ ppm
$EPC_{WH1} = 15 \times 107 = 1,600$ μg/ℓ
$EPC_{WH2} = 13.8 \times 45 = 620$ μg/ℓ
$EPC_{LH} = 0.002 \times 620 = 1.2$ μg/g

$EPC_{WE1} = 50 \times 10 = 500$ μg/ℓ
$EPC_{WE2} = 18,000$ μg/ℓ (to prevent tainting)
$EPC_{LE} = 0.002 \times 500 = 1$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.5E4 (20)		107 (0.05)		
Water, $\mu g/l$ (ppm Wt)			6.75E5	1.0E3	620	500	
Land, $\mu g/g$ (ppm Wt)			1.4E3	2.0E0	1.2	1	

*To be multiplied by dilution factor

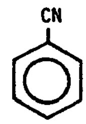
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			107 (0.05)		
Water, $\mu g/l$ (ppm Wt)			620	500	
Land, $\mu g/g$ (ppm Wt)			1.2	1	

CATEGORY: 9

WLN: NCR

BENZONITRILE: C_7H_5N (cyanobenzene, phenyl cyanide).
A colorless, flammable liquid with an almond-like odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 103; mp: -13; bp: 190-192; d: 1.010^{15}_{15}; vap. press.: 1 mm at 28.2°; slightly soluble in cold water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Benzonitrile decomposes when heated to give toxic vapors.

TOXIC PROPERTIES, HEALTH EFFECTS:

Benzonitrile is considered to be highly toxic (ref. 9).
LD_{Lo} (oral, rat): 720 mg/kg.
LC_{Lo} (inhalation, rat): 950 ppm for 8 hours

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 720 = 3.24 \times 10^4$ µg/m³
Water, Health: $15 \times 3.24 \times 10^4 = 4.9 \times 10^5$ µg/ℓ
Land, Health: $0.002 \times 4.9 \times 10^5 = 980$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 720 = 77$ µg/m³
$EPC_{AH3} = 0.081 \times 720 = 58$ µg/m³
$EPC_{WH1} = 15 \times 58 = 870$ µg/ℓ
$EPC_{WH2} = 0.4 \times 720 = 290$ µg/ℓ
$EPC_{LH} = 0.002 \times 290 = 0.6$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.2E4		58		
Water, $\mu g/l$ (ppm Wt)			4.9E5		290		
Land, $\mu g/g$ (ppm Wt)			9.8E2		0.6		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			58		
Water, $\mu g/l$ (ppm Wt)			290		
Land, $\mu g/g$ (ppm Wt)			0.6		

CATEGORY: 9

WLN: NCX&&XCN

TETRAMETHYLSUCCINONITRILE: $C_8H_{12}N_2$ (TSN,TMSN).
Crystallizes in plates; nearly odorless.

STRUCTURE:

$(CH_3)_2$–C–CN
$(CH_3)_2$–C–CN

PROPERTIES:

Molecular wt: 136.22; mp: 169 (sublimes); d: 1.070; slightly soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

TOXIC PROPERTIES, HEALTH EFFECTS:

Tetramethylsuccinonitrile is used as a strong convulsant in experimental animals and in man. It is absorbed through the skin and detoxified slowly in the body. Cumulative effects were not noted in animal tests. Systemic effects caused in exposed workers included headache, nausea, and convulsions (refs. 4,9).

LC_{Lo} (inhalation, rat): 60 ppm for 2-3 hours; 6 ppm for 30 hours.
LD_{Lo} (oral, rat): 25 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 3 mg/m^3 (0.5 ppm)

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.0×10^3 $\mu g/m^3$ (0.5 ppm)
Water, Health: $15 \times 3.0 \times 10^3 = 4.5 \times 10^4$ $\mu g/\ell$
Land, Health: $0.002 \times 4.5 \times 10^4 = 90$ $\mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 3/420 = 7$ $\mu g/m^3$
$EPC_{AH1a} = 0.5/420 = 0.001$ ppm
$EPC_{WH1} = 15 \times 7 = 105$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 3 = 41$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 41 = 0.08$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.0E3 (0.5)		7 (0.001)		
Water, $\mu g/l$ (ppm Wt)			4.5E4		41		
Land, $\mu g/g$ (ppm Wt)			9.0E1		0.08		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			7 (0.001)		
Water, $\mu g/l$ (ppm Wt)			41		
Land, $\mu g/g$ (ppm Wt)			0.08		

CATEGORY: 10A

WLN: Z2

ETHYLAMINE: C_2H_7N (1-aminoethane, ethanamine)

A colorless, flammable liquid with a strong ammoniacal odor.

STRUCTURE:

$CH_3CH_2NH_2$

PROPERTIES:

Molecular wt: 45.10; bp: 16.6°; d: 0.689^{15}_{15}; pK_a: 10.75 (ref. 37); vap. press.: 400 mm at 2°; miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Ethylamine is a strong base and a normal constituent of human urine (ref. 37).

Rural concentration in air has been reported as 21 ppb (ref. 1). This is equivalent to 38.7 $\mu g/m^3$. This value may be unduly high since it is representative of an agricultural setting.

TOXIC PROPERTIES, HEALTH EFFECTS:

Experiments with animals indicate irritation of the cornea as well as lung, liver, and kidney damage for a 6-week exposure at levels of 100 ppm (ref. 4).

LD_{Lo} (oral, rat): 400 mg/kg.

LC_{Lo} (inhalation, rat): 3,000 ppm/4 hr.

Aquatic toxicity: TLm 96: 100-10 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 18 mg/m^3 (10 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.8×10^4 $\mu g/m^3$ (10 ppm)

Water, Health: $15 \times 1.8 \times 10^4 = 2.7 \times 10^5$ $\mu g/\ell$

Land, Health: $0.002 \times 2.7 \times 10^5 = 540$ $\mu g/g$

Air, Ecology:

Water, Ecology: $100 \times 10 = 1.0 \times 10^3$ $\mu g/\ell$

Land, Ecology: $0.002 \times 1.0 \times 10^3 = 2$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 18/420 = 43$ $\mu g/m^3$

$EPC_{AH1a} = 10/420 = 0.024$ ppm

$EPC_{WH1} = 15 \times 43 = 645$ $\mu g/\ell$

$EPC_{WH2} = 13.8 \times 18 = 248$ $\mu g/\ell$

$EPC_{LH} = 0.002 \times 248 = 0.5$ $\mu g/g$

$EPC_{WE1} = 50 \times 10 = 500$ $\mu g/\ell$

$EPC_{LE} = 0.002 \times 500 = 1$ $\mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.8E4 (10)		43 (0.024)		
Water, $\mu g/l$ (ppm Wt)			2.7E5	1.0E3	248	500	
Land, $\mu g/g$ (ppm Wt)			5.4E2	2.0E0	0.5	1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			43 (0.024)		
Water, $\mu g/l$ (ppm Wt)			248	500	
Land, $\mu g/g$ (ppm Wt)			0.5	1	

CATEGORY: 10A

WLN: Z2Q

ETHANOLAMINE: C_2H_7NO (2-aminoethanol, 2-hydroxylethylamine).
A colorless, oily liquid; faint, ammoniacal odor.

STRUCTURE:

$H_2NCH_2CH_2OH$

2-Aminoethanol

PROPERTIES:

Molecular wt: 61.10; bp: 171-172°; pK_a: 9.44 (ref. 38);
d: 1.022^{20}_{20}; miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Ethanolamine is a strong base, and a normal constituent of human urine (ref. 37).

TOXIC PROPERTIES, HEALTH EFFECTS:

Animal studies indicate that ethanolamine has an irritant and necrotic effect on the skin (ref. 4).

LD_{50} (oral, rat): 2,100 mg/kg.

Aquatic toxicity: TLm 96: 1,000-100 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 6 mg/m^3 (3 ppm) (level believed sufficient to prevent systemic effects).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 6.0×10^3 µg/m^3 (3 ppm)
Water, Health: $15 \times 6 \times 10^3 = 9.0 \times 10^4$ µg/ℓ
Land, Health: $0.002 \times 9.0 \times 10^4 = 180$ µg/g

Air, Ecology:
Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ µg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 6/420 = 14$ µg/m^3
$EPC_{AH1a} = 3/420 = 0.007$ ppm
$EPC_{WH1} = 15 \times 14 = 210$ µg/ℓ
$EPC_{WH2} = 13.8 \times 6 = 83$ µg/ℓ
$EPC_{LH} = 0.002 \times 83 = 0.17$ µg/g

$EPC_{WE1} = 50 \times 100 = 5,000$ µg/ℓ
$EPC_{LE} = 0.002 \times 5,000 = 10$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			6.0E3 (3)		14 (0.007)		
Water, μg/l (ppm Wt)			9.0E4	1.0E4	83	5,000	
Land, μg/g (ppm Wt)			1.8E2	2.0E1	0.17	10	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			14 (0.007)		
Water, μg/l (ppm Wt)			83	5,000	
Land, μg/g (ppm Wt)			0.17	10	

CATEGORY: 10A

WLN: Z4, ZY2, ZX

BUTYLAMINES: $C_4H_{11}N$ (aminobutanes).
Liquid, ammoniacal odor.

Molecular wt: 73.16; soluble in water.

PROPERTIES:	mp	bp	d_4^{20}
1-aminobutane	-50	78	
2-aminobutane	-104	63	0.724
2-methyl-n-aminopropane	-72.65	44-46	0.695

STRUCTURE:

$CH_3CH_2CH_2CH_2NH_2$ 1-Aminobutane

$CH_3CH_2CH(NH_2)CH_3$ 2-Aminobutane

$CH_3-C(CH_3)_2-NH_2$ 2-Amino-2-methyl propane

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Aliphatic amines are strong bases.
The odor of butylamine is slight at less than 1 ppm (ref. 37).

TOXIC PROPERTIES, HEALTH EFFECTS:

Contact with liquids, solutions, or vapors of aliphatic amines causes strong, local irritation.

	LD_{50} oral, rat	LC_{Lo} inhalation, rat
1-aminobutane	500 mg/kg	4,000 ppm/4 hr
2-aminobutane	380 mg/kg	
2-amino-2-methylpropane	180 mg/kg	

The aquatic toxicity rating for 2-amino-2-methylpropane (tert-butylamine) is reported as TLm 96: $>$ 1,000 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 15 mg/m^3 (5 ppm): skin.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.5×10^4 $\mu g/m^3$ (5 ppm)
Water, Health: $15 \times 1.5 \times 10^4 = 2.25 \times 10^5$ $\mu g/\ell$
Land, Health: $0.002 \times 2.25 \times 10^5 = 450$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times >1{,}000 = >1.0 \times 10^5$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^5 = 200$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 15/420 = 36$ $\mu g/m^3$
$EPC_{AH1a} = 5/420 = 0.01$ ppm
$EPC_{WH1} = 15 \times 36 = 540$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 15 = 207$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 207 = 0.4$ $\mu g/g$

$EPC_{WE1} = 50 \times >1{,}000 = >50{,}000$ $\mu g/\ell$

$EPC_{LE} = 0.002 \times 50{,}000 = 100$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.5E4 (5)		36 (0.01)		
Water, $\mu g/l$ (ppm Wt)			2.25E5	>1.0E5	207	>50,000	
Land, $\mu g/g$ (ppm Wt)			4.5E2	2.0E2	0.4	100	

*To be multiplied by dilution factor

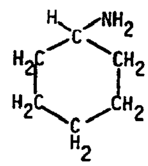
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			36 (0.01)		
Water, $\mu g/l$ (ppm Wt)			207	>50,000	
Land, $\mu g/g$ (ppm Wt)			0.4	100	

CATEGORY: 10A

WLN:

CYCLOHEXYLAMINE: $C_6H_{13}N$ (aminocyclohexane, hexahydroaniline). A liquid, with a strong, fishy, amine odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 99.06; mp: -17.7; bp: 134°; d: 0.8191; pK_a: 10.79 (ref. 37); completely miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Cyclohexylamine is a known metabolite of cyclamates (refs. 4,39). It is a strong base.

TOXIC PROPERTIES, HEALTH EFFECTS:

Vapors of cyclohexylamine are strongly irritating although, at concentrations below 10 ppm, acute effects are absent (ref. 4).

LD_{50} (oral, rat): 710 mg/kg.

Cyclohexylamine appears (as the sulfate) in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 4111. The lowest dose (as the sulfate) to induce a carcinogenic response is 11 g/kg. This is equivalent to 5.5 g/kg of cyclohexylamine. The adjusted ordering number is 0.74.

Aquatic toxicity: TLm 96: 1,000-100 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 40 mg/m^3 (10 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 4.0×10^4 $\mu g/m^3$ (10 ppm)
Water, Health: $15 \times 4.0 \times 10^4 = 6.0 \times 10^5$ $\mu g/\ell$
Land, Health: $0.002 \times 6.0 \times 10^5 = 1.2 \times 10^3$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 40/420 = 95$ $\mu g/m^3$
$EPC_{AH1a} = 10/420 = 0.024$ ppm
$EPC_{WH1} = 15 \times 95 = 1,430$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 40 = 550$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 550 = 1$ $\mu g/g$

$EPC_{WE1} = 50 \times 100 = 5,000$ $\mu g/\ell$
$EPC_{LE} = 0.002 \times 5,000 = 10$ $\mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.0E4 (10)		95 (0.024)		
Water, $\mu g/l$ (ppm Wt)			6.0E5	1.0E4	550	5,000	
Land, $\mu g/g$ (ppm Wt)			1.2E3	2.0E1	1	10	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

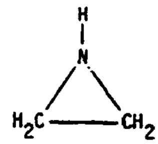
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			95 (0.024)		
Water, $\mu g/l$ (ppm Wt)			550	5,000	
Land, $\mu g/g$ (ppm Wt)			1	10	

CATEGORY: 10B

WLN: T3MTJ

ETHYLENEIMINE: C_2H_5N (aziridine, azacyclopropane).
A colorless liquid; intense, ammoniacal odor; fumes in air.

STRUCTURE:



PROPERTIES:

Molecular wt: 43.07; mp: -73.96; bp: 55-56; d: 0.832;
vap. press.: 160 mm at 20°; vap. d: 1.48; miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Ethyleneimine is an extremely reactive compound; it undergoes ring-opening reactions similar to those undergone by ethylene oxide (ref. 39). Ethyleneimine hydrolyses in water to give ethanolamine. Ethyleneimine is polymerized to polyethyleneimine, which is used as a flocculant in water treatment. Polyethyleneimine is also used in the paper and textile industries (ref. 40).

The ammoniacal odor of ethyleneimine is detectable at 2 ppm (ref. 41).

Ethyleneimine is not known to occur in nature (ref. 40).

TOXIC PROPERTIES, HEALTH EFFECTS:

Ethyleneimine is regarded as highly toxic by inhalation, skin contact, and ingestion. It is a potent irritant, causing blisters. Toxic effects due to a 2-3 minute exposure to the vapor were not apparent until after 3 hours (ref. 4).

Ethyleneimine causes chromosome aberrations in mammalian cells (ref. 42). It is reported to cause cancer in mice and in rats, and the animal studies show that a high incidence of hepatomas and pulmonary tumors result from oral administration (ref. 40).

The EPA/NIOSH ordering number is 4212. The lowest toxic dose to induce carcinogenic effect in animals is recorded as 20 mg/kg. The adjusted ordering number is 210.6.

LD_{50} (oral, rat): 15 mg/kg.

LC_{Lo} (inhalation, rat): 25 ppm/8 hr.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 1 mg/m^3 (0.5 ppm). (This TLV does not consider the carcinogenic potential of ethyleneimine.)

Ethyleneimine is the subject of a NIOSH Hazard Review Document (ref. 43).

Ethyleneimine is designated by OSHA as a cancer suspect agent; special precautions for exposed workers are prescribed (ref. 17), including monitoring, control methods, and medical surveillance.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/210.6 = 332\ \mu g/m^3$

Water, Health: $15 \times 332 = 5 \times 10^3\ \mu g/\ell$

Land, Health: $0.002 \times 5 \times 10^3 = 10\ \mu g/g$

Air, Ecology:

Water, Ecology:

Land, Ecology

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 1/420 = 2.4\ \mu g/m^3$

$EPC_{AH1a} = 0.5/420 = 0.001$ ppm

$EPC_{WH1} = 15 \times 2.4 = 36\ \mu g/\ell$

$EPC_{WH2} = 13.8 \times 1 = 14\ \mu g/\ell$

$EPC_{LH} = 0.002 \times 14 = 0.028\ \mu g/g$

$EPC_{AC2} = 10^3/(6 \times 210.6) = 0.8\ \mu g/m^3$

$EPC_{WC} = 15 \times 0.8 = 12\ \mu g/\ell$

$EPC_{LC} = 0.002 \times 12 = 0.024\ \mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.32E2		0.8		
Water, $\mu g/l$ (ppm Wt)			5.0E3		12		
Land, $\mu g/g$ (ppm Wt)			1.0E1		0.024		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			2.4 (0.001)		0.8
Water, $\mu g/l$ (ppm Wt)			14		12
Land, $\mu g/g$ (ppm Wt)			0.028		0.024

CATEGORY: 10B

WLN: 1M1

DIMETHYLAMINE: C_2H_7N.

A colorless gas with a strong ammoniacal odor.

STRUCTURE:

$(CH_3)_2NH$

PROPERTIES:

Molecular wt: 45.09; bp: 7.4; d: 0.6804^{20}_{4}; vap. press.: 2 atm at 25° (ref. 37); vap. d: 1.55; miscible with water; pK_a: 10.61 (ref. 37).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Dimethylamine is a normal constituent of human urine (ref. 37). Aliphatic amines are strong bases.

The rural concentration of dimethylamine is reported as 89 ppb (ref. 1). This is equivalent to 163.80 $\mu g/m^3$. This value is probably unduly high because it is representative of an agricultural setting. The odor recognition level is reported as 1.10 mg/m^3 (ref. 3) and the odor threshold as 0.047 ppm or 0.09 mg/m^3 (ref. 29).

TOXIC PROPERTIES, HEALTH EFFECTS:

Dimethylamine is similar to ammonia in its chemical and toxicological properties. It is a strong irritant to eyes and upper respiratory tract.

LD_{50} (oral, rat): 698 mg/kg.

Aquatic toxicity: TLm 96: 100-10 ppm (ref. 2).

A concentration of 7 mg/ℓ in water is reported to cause tainting of fish flesh (ref. 36).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 18 mg/m^3 (10 ppm). (This level is established to prevent respiratory irritation. The odor threshold is much lower.)

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.8×10^4 $\mu g/m^3$ (10 ppm)

Water, Health: $15 \times 1.8 \times 10^4 = 2.7 \times 10^5$ $\mu g/\ell$

Land, Health: $0.002 \times 2.7 \times 10^5 = 540$ $\mu g/g$

Air, Ecology:

Water, Ecology: $100 \times 10 = 1 \times 10^3$ $\mu g/\ell$

Land, Ecology: $0.002 \times 1 \times 10^3 = 2$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 18/420 = 43$ $\mu g/m^3$

$EPC_{AH1a} = 10/420 = 0.024$ ppm

$EPC_{WH1} = 15 \times 43 = 645$ $\mu g/\ell$

$EPC_{WH2} = 13.8 \times 18 = 248$ $\mu g/\ell$

$EPC_{LH} = 0.002 \times 248 = 0.5$ $\mu g/g$

$EPC_{WE1} = 50 \times 10 = 500$ $\mu g/\ell$

$EPC_{LE} = 0.002 \times 500 = 1$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m^3 (ppm Vol)			1.8E4 (10)		43 (0.024)		
Water, μg/l (ppm Wt)			2.7E5	1.0E3	248	500	
Land, μg/g (ppm Wt)			5.4E2	2.0E0	0.5	1	

*To be multiplied by dilution factor

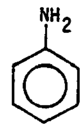
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m^3 (ppm Vol)			43 (0.024)		
Water, μg/l (ppm Wt)			248	500	
Land, μg/g (ppm Wt)			0.5	1	

CATEGORY: 10C

WLN: ZR

ANILINE: C_6H_7N (phenylamine, aminobenzene).
An oily liquid; colorless when freshly distilled, darkens on exposure to air and light; disagreeable odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 93.11; bp: 184.13; d: 1.0217; pk_b: 9.3 (ref. 44); vap. press.: 1 mm at 34.8° C; volatile with steam; soluble in water, soluble in lipids (ref. 44).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Aniline was first produced by the dry distillation of indigo. It has also been isolated from coal tar. It has, in general, the characteristics of primary aromatic amines; it is a weak base. It is widely used as an intermediate in the production of chemicals used in dyes, photographic chemicals, pharmaceuticals, and in the rubber industry (ref. 44).

The odor recognition level for aniline is reported as 0.37-4.15 mg/m^3 (ref. 3).

TOXIC PROPERTIES, HEALTH EFFECTS:

The biological half-life of aniline is reported as 0.120 day for man (ref. 20). Aniline may be absorbed through the skin as well as through inhalation and cases of acute, as well as chronic, poisoning are reported (ref. 4). The oxygen transport ability of hemoglobin is impaired by aniline; human death has resulted from exposure to high concentrations of aniline (ref. 45). Ingestion of 350 mg/kg has also resulted in human death.

LD_{50} (oral, rat): 440 mg/kg.

LC_{50} (inhalation, rat): 250 ppm for 4 hours.

There are no adequate data to indicate that aniline is carcinogenic to man or to animals (ref. 44). However, several aniline derivatives have produced oncogenic responses in test animals (ref. 2).

Aquatic toxicity: 96-hour TLm is 100-10 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 19 mg/m^3 (5 ppm) skin.

Aniline is included in the Chemical Industry Institute of Toxicology First Priority Chemicals List (ref. 8).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.9×10^4 $\mu g/m^3$ (5 ppm)
Water, Health: $15 \times 1.9 \times 10^4 = 3.0 \times 10^5$ $\mu g/m^3$
Land, Health: $0.002 \times 3.0 \times 10^5 = 600$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 10 = 1.0 \times 10^3$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^3 = 2$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 19/420 = 45$ $\mu g/m^3$
$EPC_{AH1a} = 5/420 = 0.02$ ppm
$EPC_{WH1} = 15 \times 45 = 675$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 19 = 262$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 262 = 0.5$ $\mu g/g$

$EPC_{WE1} = 50 \times 10 = 500$ $\mu g/\ell$
$EPC_{LE} = 0.002 \times 500 = 1$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.9E4 (5)		45 (0.02)		
Water, μg/l (ppm Wt)			3.0E5	1.0E3	262	500	
Land, μg/g (ppm Wt)			6.0E2	2.0E0	0.5	1	

*To be multiplied by dilution factor

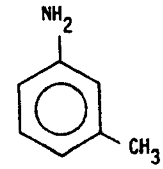
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			45 (0.02)		
Water, μg/l (ppm Wt)			262	500	
Land, μg/g (ppm Wt)			0.5	1	

CATEGORY: 10C

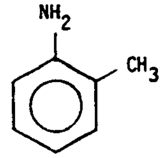
WLN: ZR B, ZR C, ZR D

AMINOTOLUENES: C_7H_9N (methyl anilines, toluidines).
2-Aminotoluene: light yellow liquid; becomes darker on exposure to air and liquid. 3-Aminotoluene: liquid.
4-Aminotoluene: leaflets, winelike odor, burning taste.

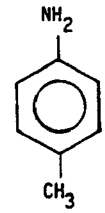
STRUCTURE:



3-Aminotoluene
(m-Toluidine)



2-Aminotoluene
(o-Toluidine)



4-Aminotoluene
(p-Toluidine)

PROPERTIES:

	Molecular wt	mp	bp	d_4^{20}	Solubility in water
2-Aminotoluene	107.16	-14.7	200.23	0.9984	Slightly soluble
3-Aminotoluene	107.16	-30.4	203.35	0.9889	Slightly soluble
4-Aminotoluene	107.16	43.7	200.55	0.9619	Slightly soluble

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Aminotoluenes are formed by reduction of the corresponding nitrotoluenes.

TOXIC PROPERTIES, HEALTH EFFECTS:

Aromatic amines are readily absorbed through the skin. The toxicity of toluidines is considered to be similar to that of aniline (ref. 45). Inhalation of vapor of the ortho isomer results in intoxication and irritation of the kidney and bladder. A concentration of approximately 100 ppm is considered the maximum endurable for an hour without serious consequences (ref. 9).

	LD_{50} (oral, rat)
2-Aminotoluene	900 mg/kg
3-Aminotoluene	974 mg/kg
4-Aminotoluene	656 mg/kg

Each of the aminotoluenes is reported to produce oncogenic responses in animals. The EPA/NIOSH ordering number, considering the compounds collectively, is 4212, and the lowest dose to produce an oncogenic response is 6,600 μg/kg. The adjusted ordering number for the compounds collectively is 638.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 22 mg/m^3 (5 ppm) for 2-aminotoluene. This TLV does not reflect carcinogenic potential of the aminotoluenes.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/638 = 110$ μg/m^3
Water, Health: $15 \times 110 = 1.65 \times 10^3$ μg/ℓ
Land, Health: $0.002 \times 1.65 \times 10^3 = 3$ μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 22/420 = 52$ μg/m^3
$EPC_{AH1a} = 5/420 = 0.01$ ppm
$EPC_{WH1} = 15 \times 52 = 780$ μg/ℓ
$EPC_{WH2} = 13.8 \times 22 = 304$ μg/ℓ
$EPC_{LH} = 0.002 \times 304 = 0.6$ μg/g
$EPC_{AC2} = 10^3/(6 \times 638) = 0.26$ μg/m^3
$EPC_{WC} = 15 \times 0.26 = 4$ μg/ℓ
$EPC_{LC} = 0.002 \times 4 = 0.008$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.10E2		0.26		
Water, μg/l (ppm Wt)			1.65E3		4		
Land, μg/g (ppm Wt)			3.0E0		0.008		

*To be multiplied by dilution factor

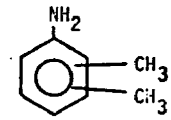
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			52 (0.01)		0.26
Water, μg/l (ppm Wt)			304		4
Land, μg/g (ppm Wt)			0.6		0.008

CATEGORY: 10C

WLN: ZR X X

DIMETHYLANILINES: $C_8H_{11}N$ (xylidines, aminodimethylbenzenes). Of the six isomeric xylidines, all except xylidine are liquids above 20° C.

STRUCTURE:



PROPERTIES:

Molecular wt: 121.09; bp: 213-226°; d: 0.97-0.99; sparingly soluble in water, soluble in lipids.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The six isomeric xylidines may be formed by the reduction of the corresponding nitro compounds.

TOXIC PROPERTIES, HEALTH EFFECTS:

Toxicity of dimethylanilines has been compared to that of aniline and methyl aniline. Depending on the species tested, the compound appears to be less toxic, equally toxic, or more toxic than the other compounds (ref. 4).

	LD_{50} (oral, rat) (in mg/kg)
2,3-xylidine	933
2,4-xylidine	467
2,5-xylidine	1,297
2,6-xylidine	840

	LD_{50} (oral, rat) (in mg/kg)
3,4-xylidine	812
3,5-xylidine	707
xylidine (mixture of isomers)	670

LC_{50} (inhalation, mouse): 149 ppm for 7 hours (ref. 4).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 25 mg/m^3 (5 ppm) skin for xylidines.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2.5×10^4 μg/m^3 (5ppm)
Water, Health: $15 \times 2.5 \times 10^4 = 3.75 \times 10^5$ μg/ℓ
Land, Health: $0.002 \times 3.75 \times 10^5 = 750$ μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 25/420 = 60$ μg/m^3
$EPC_{AH1a} = 5/420 = 0.01$ ppm
$EPC_{WH1} = 15 \times 60 = 900$ μg/ℓ
$EPC_{WH2} = 13.8 \times 25 = 345$ μg/ℓ
$EPC_{LH} = 0.002 \times 345 = 0.7$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.5E4 (5)		60 (0.01)		
Water, $\mu g/l$ (ppm Wt)			3.75E5		345		
Land, $\mu g/g$ (ppm Wt)			7.50E2		0.7		

*To be multiplied by dilution factor

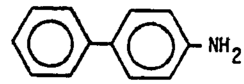
AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			60 (0.01)		
Water, $\mu g/l$ (ppm Wt)			345		
Land, $\mu g/g$ (ppm Wt)			0.7		

CATEGORY: 10C

WLN: ZR DR

STRUCTURE:



4-AMINOBIPHENYL: $C_{12}H_{11}N$ (p-phenylaniline, 4-biphenylamine). Colorless crystals that darken on exposure to light and air.

PROPERTIES:

Molecular wt: 169.24; mp: 50-2; bp: 302; slightly soluble in cold water; volatile in steam; soluble in lipids (ref. 46).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

4-Aminobiphenyl has, in general, the properties of primary aromatic amines. It is a weak base. The main commercial use of 4-aminobiphenyl in the past was that of an antioxidant in rubber (ref. 46).

4-Aminobiphenyl is a metabolite of 4-nitrobiphenyl (ref. 43).

TOXIC PROPERTIES, HEALTH EFFECTS:

A high incidence of bladder carcinomas was reported for a group of workers occupationally exposed to 4-aminobiphenyl (ref. 46). 4-Aminobiphenyl has also caused cancer in animals (ref. 2).

The EPA/NIOSH ordering number is 7526. The lowest toxic dose to induce a carcinogenic response is reported as 140 mg/kg. The adjusted ordering number is 54.

LD_{50} (oral, rat): 500 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

4-Aminobiphenyl is the subject of a NIOSH Hazard Review Document (ref. 43).

4-Aminobiphenyl is designated by OSHA as a cancer suspect agent; special precautioons for exposed workers are prescribed (ref. 17).

4-Aminobiphenyl is recognized by ACGIH as being potentially carcinogenic to humans. No TLV has been assigned to it.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/54 = 1.3 \times 10^3$ μg/m^3

Water, Health: $15 \times 1.3 \times 10^3 = 2.0 \times 10^4$ μg/ℓ

Land, Health: $0.002 \times 2.0 \times 10^4 = 40$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 500 = 53.5$ μg/m^3

$EPC_{AH3} = 0.081 \times 500 = 40.5$ μg/m^3

$EPC_{WH1} = 15 \times 40.5 = 608$ μg/ℓ

$EPC_{WH2} = 0.4 \times 500 = 200$ μg/ℓ

$EPC_{LH} = 0.002 \times 200 = 0.4$ μg/g

$EPC_{AC2} = 10^3/(6 \times 54) = 3$ μg/m^3

$EPC_{WC} = 15 \times 3 = 45$ μg/ℓ

$EPC_{LC} = 0.002 \times 45 = 0.1$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.3E3		3		
Water, $\mu g/l$ (ppm Wt)			2.0E4		45		
Land, $\mu g/g$ (ppm Wt)			4.0E1		0.1		

*To be multiplied by dilution factor

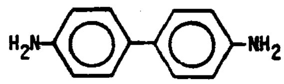
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			40.5		3
Water, $\mu g/l$ (ppm Wt)			200		45
Land, $\mu g/g$ (ppm Wt)			0.4		0.1

CATEGORY: 10C

WLN: ZR DR DZ

BENZIDINE: $C_{12}H_{12}N_2$ (4,4'-diaminodiphenyl, 4-4'-diphenylenediamine).
Colorless crystals; darken on exposure to light and air.

STRUCTURE:



PROPERTIES:

Molecular wt: 184.26; mp: 125; bp: 400^{740};
slightly soluble in cold water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Benzidine has, in general, the characteristics of primary aromatic amines. It is a weak base. Benzidine and its salts are used in the synthesis of dyes (ref. 46).

TOXIC PROPERTIES, HEALTH EFFECTS:

Benzidine is believed to be absorbed through the skin as well as through inhalation.

LD_{50} (oral, rat): 309 mg/kg.

A high incidence of bladder tumors among workers handling benzidine is reported (refs. 4, 46). Inhalation of 18 mg/m^3 for 13 years resulted in carcinoma in exposed workers (ref. 2).

The compound is reported to cause cancer in animals also. Cancer resulted in rats exposed intermittently via inhalation to 10 mg/m^3 for 56 weeks.

The EPA/NIOSH ordering number is 7426. The lowest toxic dose reported to induce a carcinogenic response is 2,100 mg/kg. The adjusted ordering number is 3.5.

Aquatic toxicity: TLm 96: 10-1 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Benzidine production is recognized by ACGIH to be associated with a substance or substances considered potential human carcinogens. No TLV has been assigned.

Benzidine is the subject of a NIOSH Hazard Review Document (ref. 43).

Benzidine is designated by OSHA as a cancer suspect agent; special precautions for exposed workers are prescribed (ref. 17).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 309 = 1.4 \times 10^4$ μg/m^3

Water, Health: $15 \times 1.4 \times 10^4 = 2.1 \times 10^5$ μg/ℓ

Land, Health: $0.002 \times 2.1 \times 10^5 = 420$ μg/g

Air, Ecology:

Water, Ecology: $100 \times 1 = 100$ μg/ℓ

Land, Ecology: $0.002 \times 100 = 0.2$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 309 = 33$ μg/m^3

$EPC_{AH3} = 0.081 \times 309 = 25$ μg/m^3

$EPC_{WH1} = 15 \times 25 = 375$ μg/ℓ

$EPC_{WH2} = 0.4 \times 309 = 124$ μg/ℓ

$EPC_{LH} = 0.002 \times 124 = 0.25$ μg/g

$EPC_{AC2} = 10^3/(6 \times 3.5) = 48$ μg/m^3

$EPC_{WC} = 15 \times 48 = 720$ μg/ℓ

$EPC_{LC} = 0.002 \times 720 = 1.4$ μg/g

$EPC_{WE1} = 50 \times 1 = 50$ μg/ℓ

$EPC_{LE} = 0.002 \times 50 = 0.1$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m^3 (ppm Vol)			1.4E4		25		
Water, μg/l (ppm Wt)			2.1E5	1.0E2	124	50	
Land, μg/g (ppm Wt)			4.2E2	2.0E-1	0.25	0.1	

*To be multiplied by dilution factor

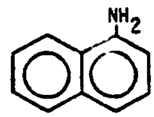
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m^3 (ppm Vol)			25		48
Water, μg/l (ppm Wt)			124	50	720
Land, μg/g (ppm Wt)			0.25	0.1	1.4

CATEGORY: 10C

WLN: L66J BZ

1-AMINONAPHTHALENE: $C_{10}H_9N$ (1-naphthylamine, α-Naphthylamine).
White crystals; darken on exposure to light and air.

STRUCTURE:



PROPERTIES:

Molecular wt: 143.19; mp: 50; sublimes; bp: 300; d: 1.1229^{25}_{25};
vap. press.: 1 mm at 104° C; soluble to 0.167 percent in H_2O at 25°; volatile in steam.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

1-Naphthylamine does not occur as such in nature, but has been isolated from coal tar (ref. 44). It has, in general, the characteristics of primary aromatic amines. It is a weak base.

TOXIC PROPERTIES, HEALTH EFFECTS:

Exposure to 1-aminonaphthalene contaminated with 4-10 percent 2-aminonaphthalene is associated with human bladder cancer (ref. 44). The metabolite, N-hydroxy-1-naphthalene, has also been shown to be carcinogenic (ref. 43). Animal studies indicate the compound is less carcinogenic than the 2-isomer aminonaphthalene .

The EPA/NIOSH ordering number for 1-aminonaphthalene is 3101. The lowest toxic dose to induce an oncogenic response is 25 mg/kg. The adjusted ordering number is 124.

LD_{50} (oral, rat): 779 mg/kg.

Aquatic toxicity: TLm 96: 10-1 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

1-Aminonaphthalene is the subject of a NIOSH Hazard Review Document (ref. 43).

OSHA standards dealing with exposure of employees to 1-naphthylamine have been established, taking into consideration evidence that 1-naphthylamine may cause cancer (ref. 17).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/124 = 564\ \mu g/m^3$
Water, Health: $15 \times 564 = 8.5 \times 10^3\ \mu g/\ell$
Land, Health: $0.002 \times 8.5 \times 10^3 = 17\ \mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 1 = 100\ \mu g/\ell$
Land, Ecology: $0.002 \times 100 = 0.2\ \mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 779 = 83\ \mu g/m^3$
$EPC_{AH3} = 0.081 \times 779 = 63\ \mu g/m^3$
$EPC_{WH1} = 15 \times 63 = 946\ \mu g/\ell$
$EPC_{WH2} = 0.4 \times 779 = 312\ \mu g/\ell$
$EPC_{LH} = 0.002 \times 312 = 0.6\ \mu g/g$
$EPC_{AC2} = 10^3/(6 \times 124) = 1.3\ \mu g/m^3$
$EPC_{WC} = 15 \times 1.3 = 20\ \mu g/\ell$
$EPC_{LC} = 0.002 \times 20 = 0.04\ \mu g/g$

$EPC_{WE1} = 50 \times 1 = 50\ \mu g/\ell$
$EPC_{LE} = 0.002 \times 50 = 0.1\ \mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.64E2		1.3		
Water, $\mu g/l$ (ppm Wt)			8.5E3	1.0E2	20	50	
Land, $\mu g/g$ (ppm Wt)			1.7E1	2.0E-1	0.04	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

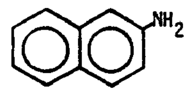
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			63		1.3
Water, $\mu g/l$ (ppm Wt)			312	50	20
Land, $\mu g/g$ (ppm Wt)			0.6	0.1	0.04

CATEGORY: 10C

WLN: L66J CZ

2-AMINONAPHTHALENE: $C_{10}H_9N$ (2-naphthylamine, β-naphthylamine).
White crystals that darken on exposure to light and air; volatile with steam.

STRUCTURE:



PROPERTIES:

Molecular wt: 143.19; mp: 113; bp: 306; d: 1.0614_4^{98}; vap. press.: 1 mm at 108° C; volatile in steam; slightly soluble in cold water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

2-Naphthylamine does not occur as such in nature, but is formed by the pyrolisis of nitrogen-containing organic matter. It has been isolated from coal-tar (ref. 44). It has, in general, the characteristics of primary aromatic amines. It is a weak base.

TOXIC PROPERTIES, HEALTH EFFECTS:

Epidemiological studies have shown that occupational exposure to 2-aminonaphthalene is strongly associated with the occurrence of bladder cancer. There is no doubt that the compound is a human bladder carcinogen (ref. 44). 2-Aminonaphthalene is also reported to cause cancer in several animal species.

The EPA/NIOSH ordering number is 7628. The lowest dose to induce a carcinogenic response is reported as 18 mg/kg. The adjusted ordering number is 423.8.

LD_{50} (oral, rat): 727 mg/kg.

Aquatic toxicity: TLm 96: 10-1 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

2-Aminonaphthalene is recognized by ACGIH as a carcinogenic agent in humans. No TLV has been assigned.

β-Naphthylamine was the subject of a NIOSH Hazard Review Document (ref. 43).

OSHA standards dealing with exposure of employees to 2-naphthylamine has been established taking into consideration substantial evidence that 2-naphthylamine is known to cause cancer (ref. 17).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/423.8 = 165$ μg/m^3
Water, Health: $15 \times 165 = 2.5 \times 10^3$ μg/ℓ
Land, Health: $0.002 \times 2.5 \times 10^3 = 5$ μg/g

Air, Ecology:
Water, Ecology: $100 \times 1 = 100$ μg/ℓ
Land, Ecology: $0.002 \times 100 = 0.2$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 727 = 78$ μg/m^3
$EPC_{AH3} = 0.081 \times 727 = 59$ μg/m^3
$EPC_{WH1} = 15 \times 59 = 3{,}500$ μg/ℓ
$EPC_{WH2} = 0.4 \times 727 = 291$ μg/ℓ
$EPC_{LH} = 0.002 \times 291 = 0.6$ μg/g
$EPC_{AC2} = 10^3/(6 \times 423.8) = 0.4$ μg/m^3
$EPC_{WC} = 15 \times 0.4 = 6$ μg/ℓ
$EPC_{LC} = 0.002 \times 6 = 0.012$ μg/g

$EPC_{WE1} = 50 \times 1 = 50$ μg/ℓ
$EPC_{LE} = 0.002 \times 50 = 0.1$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m^3 (ppm Vol)			1.65E2		0.4		
Water, μg/l (ppm Wt)			2.5E3	1.0E2	6	50	
Land, μg/g (ppm Wt)			5.0E0	2.0E-1	0.012	0.1	

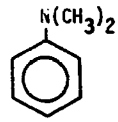
*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m^3 (ppm Vol)			59		0.4
Water, μg/l (ppm Wt)			291	50	6
Land, μg/g (ppm Wt)			0.6	0.1	0.012

CATEGORY: 10D

WLN: INI&R

STRUCTURE:



N,N-DIMETHYLANILINE: $C_8H_{11}N$ (dimethylphenylamine). An oily liquid.

PROPERTIES:

Molecular wt: 121.18; bp: 194.15; d: 0.9557; slightly soluble in water; soluble in lipids.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

TOXIC PROPERTIES, HEALTH EFFECTS:

N,N-Dimethylaniline induces toxic responses through inhalation or by absorption through the skin (refs. 4, 45). The toxic effect is considered similar to that of aniline (ref. 4). Ingestion of 50 mg/kg has resulted in human death (ref. 2).

LD_{50} (oral, rat): 1,410 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 25 mg/m^3 (5 ppm) skin.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2.5×10^4 µg/m^3 (5ppm)
Water, Health: $15 \times 2.5 \times 10^4 = 3.75 \times 10^5$ µg/ℓ
Land, Health: $0.002 \times 3.75 \times 10^5 = 750$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 25/420 = 60$ µg/m^3
$EPC_{AH1a} = 5/420 = 0.01$ ppm
$EPC_{WH1} = 15 \times 60 = 900$ µg/ℓ
$EPC_{WH2} = 13.8 \times 25 = 345$ µg/ℓ
$EPC_{LH} = 0.002 \times 345 = 0.7$ µg/g

	EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors					
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.5E4 (5)		60 (0.01)		
Water, $\mu g/l$ (ppm Wt)			3.75E5		345		
Land, $\mu g/g$ (ppm Wt)			7.5E2		0.7		

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			60 (0.01)		
Water, $\mu g/l$ (ppm Wt)			345		
Land, $\mu g/g$ (ppm Wt)			0.7		

CATEGORY: 11

WLN: NNU1 &2/1

DIAZOMETHANE: CH_2N_2 (diazirine, azimethylene).
A yellow gas; musty odor.

STRUCTURE:

$H_2C = N \pm \ddot{N}:$

PROPERTIES:

Molecular wt: 42.05; mp: -145; bp: -23°
(ref. 41); decomposes in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Diazomethane is considered a hazardous chemical due to its instability toward heat, shock, and oxidizing agents. Because of its explosive nature and its toxicity, diazomethane is generated and used in situ when needed as a reagent.

Photolysis of diazomethane yields nitrogen and the very reactive diradical methylene.

TOXIC PROPERTIES, HEALTH EFFECTS:

Diazomethane is a highly toxic compound; its toxicity is comparable to that of phosgene. Skin irritation, chest discomfort, asthmatic symptoms, and development of hypersensitivity has been reported by chemists working with diazomethane (ref. 41). Exposure to high concentrations of diazomethane have resulted in human death (ref. 41).

TC_{Lo}(inhalation, rat): 272 mg/kg

Exposure to diazomethane is reported to cause oncogenic responses in animals. The EPA/NIOSH ordering number is 4223. The lowest dose to induce an oncogenic response is reported as 54 mg/kg. The adjusted ordering number is 78.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.4 mg/m^3 (0.2 ppm). This TLV does not recognize oncogenic potential of diazomethane.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 4×10^2 µg/m^3 (0.2 ppm)
Water, Health: $15 \times 4 \times 10^2 = 6 \times 10^3$ µg/ℓ
Land, Health: $0.002 \times 6 \times 10^3 = 12$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.4/420 = 1$ µg/m^3
$EPC_{AH1a} = 0.2/420 = 0.0005$ ppm
$EPC_{WH1} = 15 \times 1 = 15$ µg/ℓ
$EPC_{WH2} = 13.8 \times 0.4 = 5.5$ µg/ℓ
$EPC_{LH} = 0.002 \times 5.5 = 0.01$ µg/g
$EPC_{AC2} = 10^3/(6 \times 78) = 2$ µg/m^3
$EPC_{WC} = 15 \times 2 = 30$ µg/ℓ
$EPC_{LC} = 0.002 \times 30 = 0.06$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			4.0E2 (0.2)		1 (0.0005)		
Water, μg/l (ppm Wt)			6.0E3		5.5		
Land, μg/g (ppm Wt)			1.2E1		0.01		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			1 (0.0005)		2
Water, μg/l (ppm Wt)			5.5		30
Land, μg/g (ppm Wt)			0.01		0.06

CATEGORY: 11 **WLN:** ZM1

MONOMETHYLHYDRAZINE: CN_2H_6 (methylhydrazine).
Monomethylhydrazine is a liquid at room temperature, fumes in air, and has an ammonia-like odor.

STRUCTURE:

$$H_2N\text{-}\underset{\large H}{\underset{|}{N}}\text{-}CH_3$$

PROPERTIES:

Molecular wt: 46.08; mp: < -80; bp: 87^{745}; vap. press.: 49.6 mm at 25° C (ref. 41); pK_a: 8.0 (ref. 47); soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Monomethylhydrazine is synthesized for use as a rocket fuel. It dissolves in water to give a weakly basic solution.

Monomethylhydrazine undergoes autooxidation in air to give nitrogen, methanol, carbon monoxide, acetaldehyde, and various carbon or nitrogen heterocyclic compounds (ref. 47).

The odor detection level for monomethylhydrazine is reported as 1-3 ppm (ref. 4).

TOXIC PROPERTIES, HEALTH EFFECTS:

As a group, hydrazine derivatives are local irritants, convulsants, and hemolytic agents which are absorbed by all routes of administration. Monomethyhydrazine is the most toxic of the methyl derivatives of hydrazine (refs. 4, 41).

LD_{50}(oral, rat): 33 mg/kg.

LC_{50}(inhalation, rat): 74 ppm for 4 hours.

Monomethylhydrazine is reported to have caused both carcinogenic and teratogenic effects in animals. The EPA/NIOSH ordering number, based on carcinogenic potential or on teratogenic potential, is 3212. The lowest dose resulting in an oncogenic response is 3,000 mg/kg; the adjusted ordering number is 1. The lowest dose to produce a teratogenic effect is 100 mg/kg; the adjusted ordering number based on teratogenic potential is 32.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.35 mg/m^3 (0.2 ppm). This TLV does not recognize oncogenic or teratogenic potential of monomethylhydrazine.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.5×10^2 $\mu g/m^3$ (0.2 ppm)
Water, Health: $15 \times 3.5 \times 10^2 = 5.25 \times 10^3$ $\mu g/\ell$
Land, Health: $0.002 \times 5.25 \times 10^3 = 10.5$ $\mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.35/420 = 0.8$ $\mu g/m^3$
$EPC_{AH1a} = 0.2/420 = 0.0005$ ppm
$EPC_{WH1} = 15 \times 0.8 = 12$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 0.35 = 5$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 5 = 0.01$ $\mu g/g$
$EPC_{AC2} = 10^3/(6 \times 1) = 167$ $\mu g/m^3$
$EPC_{WC} = 15 \times 167 = 2,500$ $\mu g/\ell$
$EPC_{LC} = 0.002 \times 2,500 = 5$ $\mu g/g$

$EPC_{AT} = 10^3/(6 \times 32) = 5$ $\mu g/m^3$
$EPC_{WT} = 15 \times 5 = 75$ $\mu g/\ell$
$EPC_{LT} = 0.002 \times 75 = 0.15$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.5E2 (0.2)		0.8 (0.0005)		
Water, $\mu g/l$ (ppm Wt)			5.25E3		5		
Land, $\mu g/g$ (ppm Wt)			1.1E1		0.01		

*To be multiplied by dilution factor

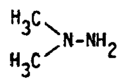
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.8 (0.0005)		5
Water, $\mu g/l$ (ppm Wt)			5		75
Land, $\mu g/g$ (ppm Wt)			0.01		0.15

CATEGORY: 11

WLN: ZN1&1

N,N-DIMETHYLHYDRAZINE: $C_2N_2H_8$ (1,1-dimethylhydrazine, dimazine, unsymmetrical dimethylhydrazine).
A colorless liquid that fumes in air with an ammoniacal or "fishy" odor.

STRUCTURE:



PROPERTIES:
Molecular wt: 60.11; bp: 63^{752}; d: 0.7914^{22}; vap. d: 2; vap. press.: 157 mm at 25° C; pK_a: 7.21 (ref. 47) miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

N,N-Dimethylhydrazine is synthesized almost exclusively for use as a rocket fuel. It is described as insensitive to shock (ref. 47), but can ignite spontaneously if absorbed in materials with large surface areas.

Solutions in water are weakly alkaline.

Odor recognition level for N,N-dimethylhydrazine is reported as 0.3 - 1 ppm (ref. 47).

TOXIC PROPERTIES, HEALTH EFFECTS:

As a group, hydrazine derivatives are local irritants, convulsants, and hemolytic agents, which are absorbed by all routes of administration (ref. 41).

N,N-Dimethylhydrazine is not considered as toxic as hydrazine or monomethylhydrazine (ref. 47).

N,N-Dimethylhydrazine is reported to have caused cancer in mice.

The EPA/NIOSH ordering number based on carcinogenic potential is 3111. The lowest dose to induce a carcinogenic response is reported as 7,902 mg/kg. The adjusted ordering number is 0.39.

LD_{50} (oral, rat): 122 mg/kg.

LC_{50} (inhalation, rat): 252 ppm for 4 hours.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 1 mg/m^3 (0.5 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1×10^3 $\mu g/m^3$ (0.5 ppm)
Water, Health: $15 \times 1 \times 10^3 = 1.5 \times 10^4$ $\mu g/\ell$
Land, Health: $0.002 \times 1.5 \times 10^4 = 30$ $\mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 1/420 = 2.4$ $\mu g/m^3$
$EPC_{AH1a} = 0.5/420 = 0.001$ ppm
$EPC_{WH1} = 15 \times 2.4 = 36$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 1 = 13.8$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 13.8 = 0.03$ $\mu g/g$

N, N-DIMETHYLHYDRAZINE

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E3 (0.5)		2.4 (0.001)		
Water, $\mu g/l$ (ppm Wt)			1.5E4		13.8		
Land, $\mu g/g$ (ppm Wt)			3.0E1		0.03		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			2.4 (0.001)		
Water, $\mu g/l$ (ppm Wt)			13.8		
Land, $\mu g/g$ (ppm Wt)			0.03		

CATEGORY: 11

WLN: 1MM1

N,N'-DIMETHYLHYDRAZINE: $C_2N_2H_8$ (1,2-dimethylhydrazine, dimethylhydrazine).

N,N'-Dimethylhydrazine is a colorless liquid that fumes in air; ammoniacal odor.

STRUCTURE:

```
H3C-N-N-CH3
    | |
    H H
```

PROPERTIES:

Molecular wt: 60.12; mp: -9; bp: 81^{753}; d: 0.8274; vap. press.: 100 mm at 28° (ref. 44); miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

N,N'-dimethylhydrazine is not known to occur freely in nature. It is manufactured only in experimental quantities (ref. 44).

TOXIC PROPERTIES, HEALTH EFFECTS:

As a group, hydrazine derivatives are local irritants, convulsants, and hemolytic agents which are absorbed by all routes of administration (ref. 41).

LD_{50} (oral, rat): 100 mg/kg.

N,N'-Dimethylhydrazine is reported to cause oncogenic effects in animals. A possible metabolite of N,N'-dimethylhydrazine, azoxymethane, produced a high yield of carcinomas of the colon in rats (ref. 44).

The EPA/NIOSH ordering number is 4415. The lowest dose to induce a carcinogenic response is 2 mg/kg. The adjusted ordering number is 2208.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/2{,}208 = 32\ \mu g/m^3$

Water, Health: $15 \times 32 = 5 \times 10^2\ \mu g/\ell$

Land, Health: $0.002 \times 5 \times 10^2 = 1\ \mu g/g$

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 100 = 11\ \mu g/m^3$

$EPC_{AH3} = 0.081 \times 100 = 8\ \mu g/m^3$

$EPC_{WH1} = 15 \times 8 = 120\ \mu g/\ell$

$EPC_{WH2} = 0.4 \times 100 = 40\ \mu g/\ell$

$EPC_{LH} = 0.002 \times 40 = 0.08\ \mu g/g$

$EPC_{AC2} = 10^3/(6 \times 2{,}208) = 0.075\ \mu g/m^3$

$EPC_{WC} = 15 \times 0.075 = 1.1\ \mu g/\ell$

$EPC_{LC} = 0.002 \times 1.1 = 0.002\ \mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.2E1		0.075		
Water, $\mu g/l$ (ppm Wt)			5.0E2		1.1		
Land, $\mu g/g$ (ppm Wt)			1.0E0		0.002		

*To be multiplied by dilution factor

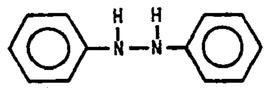
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			8		0.075
Water, $\mu g/l$ (ppm Wt)			40		1.1
Land, $\mu g/g$ (ppm Wt)			0.08		0.002

CATEGORY: 11

WLN: RMMR

1,2-DIPHENYLHYDRAZINE: $C_{12}H_{12}N_2$ (hydrazobenzene). Colorless tablets from ethanol-ether.

STRUCTURE:



PROPERTIES:

Molecular wt: 184.26; mp: 131 (decomposes); insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Hydrazobenzene is formed by mild reduction of azobenzene. In the presence of mineral acids, hydrazobenzene rearranges to benzidine.

TOXIC PROPERTIES, HEALTH EFFECTS:

Little is reported regarding the acute or chronic toxic properties of hydrazobenzene. Its properties are probably similar to other hydrazene derivatives. Hydrazobenzene is an active hemolysin (ref. 41).

LD_{50} (oral, rat): 301 mg/kg.

Exposure to hydrazobenzene is reported to produce neoplastic effects in rats and in mice. The EPA/NIOSH ordering number is 4224. The lowest dose to produce the oncogenic effect is 5,280 mg/kg. The adjusted ordering number is 0.8.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Diphenylhydrazene is on the EPA Consent Decree Priority 1 List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 301 = 1.35 \times 10^4$ µg/m^3
Water, Health: $15 \times 1.35 \times 10^4 = 2.0 \times 10^5$ µg/ℓ
Land, Health: $0.002 \times 2.0 \times 10^5 = 400$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 301 = 32$ µg/m^3
$EPC_{AH3} = 0.081 \times 301 = 24$ µg/m^3
$EPC_{WH1} = 15 \times 24 = 360$ µg/ℓ
$EPC_{WH2} = 0.4 \times 301 = 120$ µg/ℓ
$EPC_{LH} = 0.002 \times 120 = 0.24$ µg/g

1, 2-DIPHENYLHYDRAZINE

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.35E4		24		
Water, μg/l (ppm Wt)			2.0E5		120		
Land, μg/g (ppm Wt)			4.0E2		0.24		

*To be multiplied by dilution factor

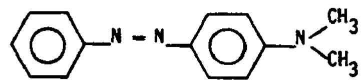
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			24		
Water, μg/l (ppm Wt)			120		
Land, μg/g (ppm Wt)			0.24		

CATEGORY: 11

WLN: 1N1&R DNUNR

p-DIMETHYLAMINOAZOBENZENE: $C_{14}H_{15}N_3$ (butter or methyl yellow, 4-dimethylaminoazobenzene, C.I. Solvent Yellow 2). Yellow leaflets.

STRUCTURE:



PROPERTIES:

Molecular wt.: 225.8; mp: 114-117; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

p-Dimethylaminoazobenzene is manufactured almost exclusively for its use as a coloring agent. The Joint FAO/WHO Expert Committee on Food Additives considers p-dimethylaminoazobenzene unsafe for use in food (ref. 48).

TOXIC PROPERTIES, HEALTH EFFECTS:

Contact dermatitis has been observed in factory workers exposed to p-dimethylaminoazobenzene (ref. 48).

Exposure to p-dimethylaminoazobenzene is reported to cause cancer in animals.

The EPA/NIOSH ordering number is 5425. The lowest dose to induce a carcinogenic response is 155 mg/kg. The adjusted ordering number is 35. Azo dyes carcinogenesis is affected by dietary factors and by hormones (ref. 49).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

P-Dimethylaminoazobenzene is the subject of a NIOSH Hazard Review Document (ref. 43).

P-Dimethylaminoazobenzene is designated by OSHA as a cancer-suspect agent; special precautions for exposed workers are prescribed (ref. 17).

FDA has declared p-dimethylaminoazobenzene a carcinogen (ref. 24).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/35 = 2.0 \times 10^3$ μg/m^3

Water, Health: $15 \times 2 \times 10^3 = 3.0 \times 10^4$ μg/ℓ

Land, Health: $0.002 \times 3.0 \times 10^4 = 60$ ug/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 35) = 5$ μg/m^3

$EPC_{WC} = 15 \times 5 = 75$ μg/ℓ

$EPC_{LC} = 0.002 \times 75 = 0.15$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.0E3		5		
Water, $\mu g/l$ (ppm Wt)			3.0E4		75		
Land, $\mu g/g$ (ppm Wt)			6.0E1		0.15		

*To be multiplied by dilution factor

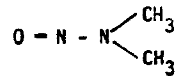
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					5
Water, $\mu g/l$ (ppm Wt)					75
Land, $\mu g/g$ (ppm Wt)					0.15

CATEGORY: 12

WLN: ONN1&1

N-NITROSODIMETHYLAMINE: $C_2H_6N_2O$ (dimethylnitrosoamine).
A yellow liquid.

STRUCTURE:



PROPERTIES:

Molecular wt: 74.08; bp: 154; d: 1.0048; miscible with water in all proportions; soluble in lipids.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Formation of nitrosoamines may occur in air, water, soil, food, and in the gastrointestinal tract. The precursors associated with nitrosoamine formation (secondary amines and nitrites or nitrogen oxides) are ubiquitous in nature. Amines may be formed by the anaerobic decay of nitrogenous matter (plants, animals, excrement), and nitrites may be formed by the microbial reduction of nitrates (ref. 50). Nitrosoamines are rapidly decomposed by photolysis.

Estimated concentrations of nitrosoamines include the following: air (major population centers)--0.2 $\mu g/m^3$; drinking water--<1 μg/day; dietary intake--a few μg/day (ref. 50).

There is some indication that traces of N-nitrosodimethylamine occur in various foods (ref. 46).

TOXIC PROPERTIES, HEALTH EFFECTS:

The biological activity of dimethylnitrosoamine (or its metabolites) includes acute and chronic toxicity, carcinogenicity, and teratogenicity in experimental animals.

LD_{50} (oral, rat): 26 mg/kg.

LD_{50} (inhalation, rat): 78 ppm (4 hours).

N-Nitrosodimethylamine is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 4429. The lowest dosage resulting in an oncogenic response is 0.075 mg/kg (ref. 50). The adjusted ordering number is 59,053. The EPA/NIOSH ordering number based on teratogenicity is 3101. The lowest dosage to produce teratogenic effects is 13 mg/kg. The adjusted ordering number based on teratogenicity is 238.5.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Nitrosoamines. including N-Nitrosodimethylamine appears on the EPA Consent Decree List with an assigned priority of 1.

Nitrosoamines are included in the ACGIH List of Industrial Substances Suspect of Carcinogenic Potential for Man. No TLV is specified.

N-Nitrosodimethylamine is the subject of a NIOSH Hazard Review Document (ref. 43). OSHA Standards dealing with exposure of employees to N-nitrosodimethylamine have been established, taking into consideration substantial evidence that the compound is known to cause cancer (ref. 17).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/59{,}053 = 1.2\ \mu g/m^3$
Water, Health: $15 \times 1.2 = 18\ \mu g/\ell$
Land, Health: $0.002 \times 18 = 0.036\ \mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 26 = 2.8\ \mu g/m^3$
$EPC_{AH3} = 0.081 \times 26 = 2.1\ \mu g/m^3$
$EPC_{WH1} = 15 \times 2.1 = 31.5\ \mu g/\ell$
$EPC_{WH2} = 0.4 \times 26 = 10.4\ \mu g/\ell$
$EPC_{LH} = 0.002 \times 10.4 = 0.02\ \mu g/g$
$EPC_{AC2} = 10^3/(6 \times 59{,}053) = 0.003\ \mu g/m^3$
$EPC_{WC} = 15 \times 0.003 = 0.045\ \mu g/\ell$
$EPC_{LC} = 0.002 \times 0.045 = 9 \times 10^{-5}\ \mu g/g$

$EPC_{AT} = 10^3/(6 \times 238.5) = 0.70\ \mu g/m^3$
$EPC_{WT} = 15 \times 0.7 = 10.5\ \mu g/\ell$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.2E0		0.003		<0.2†
Water, $\mu g/l$ (ppm Wt)			1.8E1		0.045		<1‡
Land, $\mu g/g$ (ppm Wt)			3.6E-2		$9x10^{-5}$		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			2.1		0.003
Water, $\mu g/l$ (ppm Wt)			10.4		0.045
Land, $\mu g/g$ (ppm Wt)			0.02		$9x10^{-5}$

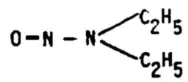
†Value is representative of major population centers. No rural concentration is reported.

‡Drinking water.

CATEGORY: 12

WLN: ONN2&2

STRUCTURE:



N-NITROSODIETHYLAMINE: $C_4H_{10}N_2O$ (diethylnitrosoamine).
A yellow, volatile liquid.

PROPERTIES:

Molecular wt: 102. 14; bp: 176.9; d: 0.9422_4^{20};
moderately soluble in water, soluble in lipids.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Formation of nitrosoamines may occur in air, water, soil, food, and in the gastrointestinal tract. The precursors associated with nitrosoamine formation (secondary amines and nitrites or nitrogen oxides) are ubiquitous in nature. Amines may be formed by the anaerobic decay of nitrogenous matter (plants, animals, excrement), and nitrites may be formed by the microbial reduction of nitrates (ref. 50). Nitrosoamines are rapidly decomposed by photolysis.

Estimated concentrations of nitrosoamines include the following: air (major population centers)--0.2 $\mu g/m^3$; drinking water--<1 μg/day; dietary intake--few μg/day (ref. 50). There is some indication that traces of N-nitrosodiethylamine also occur in various foods (ref. 46).

TOXIC PROPERTIES, HEALTH EFFECTS:

The biological activity of diethylnitrosoamine (or its metabolites) include: acute and chronic toxicity; carcinogenicity, and teratogenicity in experimental animals (refs. 50, 46, 2). There is some experimental evidence that acute toxicity of alkyl nitrosoamines decreases with increase in the length of the alkyl chain (refs. 50, 51).

LD_{50} (intravenous, rat): 157 mg/kg.

N-Nitrosodiethylamine is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 6929. The lowest dosage affecting an oncogenic response is 12 mg/kg. The adjusted ordering number is 577.

The EPA/NIOSH ordering number based on teratogenic effects is 4304. The lowest dose affecting a teratogenic response is 17 mg/kg. The adjusted ordering number based on teratogenic potential is 253.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Nitrosoamines including diethylnitrosoamine, appear on EPA Consent Decree List with an assigned priority of 1.

Nitrosoamines are included in the ACGIH List of Industrial Substances Suspect of Carcinogenic Potential for Man.

No TLV is specified.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/577 = 120\ \mu g/m^3$	Air, Ecology:
Water, Health: $15 \times 120 = 1.8 \times 10^3\ \mu g/\ell$	Water, Ecology:
Land, Health: $0.002 \times 1.8 \times 10^3 = 3.6\ \mu g/g$	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 157 = 16.8\ \mu g/m^3$

$EPC_{AH3} = 0.081 \times 157 = 12.7\ \mu g/m^3$

$EPC_{WH1} = 15 \times 12.7 = 191\ \mu g/\ell$

$EPC_{WH2} = 0.4 \times 157 = 62.8\ \mu g/\ell$

$EPC_{LH} = 0.002 \times 62.8\ \mu g/g = 0.13\ \mu g/g$

$EPC_{AC2} = 10^3/(6 \times 577) = 0.29\ \mu g/m^3$	$EPC_{AT} = 10^3/(6 \times 253) = 0.66\ \mu g/m^3$
$EPC_{WC} = 15 \times 0.29 = 4.4\ \mu g/\ell$	$EPC_{WT} = 15 \times 0.66 = 9.9\ \mu g/\ell$
$EPC_{LC} = 0.002 \times 4.4 = 0.009\ \mu g/g$	$EPC_{LT} = 0.002 \times 9.9 = 0.02\ \mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.2E2		0.29		<.2†
Water, μg/l (ppm Wt)			1.8E3		4.4		<1‡
Land, μg/g (ppm Wt)			3.6E0		0.009		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			12.7		0.29
Water, μg/l (ppm Wt)			62.8		4.4
Land, μg/g (ppm Wt)			0.13		0.009

†Value is representative of major population centers. No rural concentration is reported.
‡Drinking water.

CATEGORY: 13A

WLN: SH1

METHANETHIOL: CH_3SH (methyl mercaptan).
A colorless gas; odor of rotten cabbage.

STRUCTURE:

```
   H
   |
 H-C-SH
   |
   H
```

PROPERTIES:

Molecular wt: 48.1; mp: -123.1; bp: 7.6; d: 0.868; vap. d: 1.66; vap. press.: 2 atmos at 26.1°; slightly soluble in hot water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Methanethiol is found in coal tar. It is also formed catalytically from methanol and hydrogen sulfide.

The odor of methanethiol is stronger and more unpleasant than that of hydrogen sulfide (ref. 4). The odor threshold level is reported as 0.0021 ppm (ref. 29). Methanethiol is flammable and emits SO_2 on burning. It will also react with hot water or steam (ref. 9).

TOXIC PROPERTIES, HEALTH EFFECTS:

There is a close toxicologic similarity between methanethiol and hydrogen sulfide. Acute toxicity is characterized by respiratory effects, including respiratory paralysis and edema (ref. 4).

LD_{50} (subcutaneous, mouse): 2.4 mg/kg.

LC_{Lo} (inhalation, rat): 10,000 ppm.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 1 mg/m^3 (0.5 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.0×10^3 $\mu g/m^3$ (0.5 ppm)
Water, Health: $15 \times 1.0 \times 10^3 = 1.5 \times 10^4$ $\mu g/\ell$
Land, Health: $0.002 \times 1.5 \times 10^4 = 30$ $\mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 1/420 = 2.4$ $\mu g/m^3$
$EPC_{AH1a} = 0.5/420 = 0.001$ ppm
$EPC_{WH1} = 15 \times 2.4 = 36$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 1 = 13.8$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 13.8 = 0.03$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E3 (0.5)		2.4 (0.001)		
Water, $\mu g/l$ (ppm Wt)			1.5E4		13.8		
Land, $\mu g/g$ (ppm Wt)			3.0E1		0.03		

*To be multiplied by dilution factor

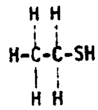
AMBIENT LEVEL GOALS					
	I. *Current or Proposed Ambient Standards or Criteria*		II. *Toxicity Based Estimated Permissible Concentration*		III. *Zero Threshold Pollutants Estimated Permissible Concentration*
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			2.4 (0.001)		
Water, $\mu g/l$ (ppm Wt)			13.8		
Land, $\mu g/g$ (ppm Wt)			0.03		

CATEGORY: 13A

WLN: SH2

ETHANETHIOL: C_2H_5SH (ethyl mercaptan, ethyl thioalcohol).
A colorless liquid; penetrating, garlic odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 62.13; mp: -147; bp: 36.2; d: 0.83907;
vap. d: 2.14; vap. press.: 400 mm at 17.7°; slightly soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The most significant characteristic of ethanethiol is the intense odor. The odor threshold is also reported as 1 ppb (ref. 29).

Rural background concentration is reported as 1 ppb (ref. 1). This is equivalent to 2.5 $\mu g/m^3$.

Ethanethiol reacts with water, steam, acid, or heat to produce toxic and flammable vapors, such as SO_x (ref. 9).

TOXIC PROPERTIES, HEALTH EFFECTS:

The lowest concentration of ethanethiol resulting in a toxic response in a human is reported as 4 ppm. This concentration resulted in effects to the central nervous system (ref. 2). Hydrogen sulfide is considered to be 10 times more toxic than ethanethiol (ref. 4).

Only slight acute toxicity for ethanethiol is indicated by animal responses.

LC_{50} (inhalation, rat): 4,420 ppm (ref. 4).

LD_{50} (oral, rat): 682 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 1 mg/m^3 (0.5 ppm) (based on intense odor).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.0×10^3 $\mu g/m^3$ (0.5 ppm)
Water, Health: $15 \times 1.0 \times 10^3 = 1.5 \times 10^4$ $\mu g/\ell$
Land, Health: $0.002 \times 1.5 \times 10^4 = 30$ $\mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 1/420 = 2.4$ $\mu g/m^3$
$EPC_{AH1a} = 0.5/420 = 0.001$ ppm
$EPC_{WH1} = 15 \times 2.4 = 36$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 1 = 13.8$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 13.8 = 0.03$ $\mu g/g$

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.0E3 (0.5)		2.4 (0.001)		2.5
Water, μg/l (ppm Wt)			1.5E4		13.8		
Land, μg/g (ppm Wt)			3.0E1		0.03		

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			2.4 (0.001)		
Water, μg/l (ppm Wt)			13.8		
Land, μg/g (ppm Wt)			0.03		

CATEGORY: 13A

WLN: SH4

STRUCTURE:

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  H H H H
  | | | |
H-C-C-C-C-SH
  | | | |
  H H H H
```

n-BUTANETHIOL: $C_4H_{10}S$ (n-butyl mercaptan, 1-butanethiol, n-butyl-thioalcohol).
A colorless, mobile liquid; heavy skunk-like odor.

PROPERTIES:

Molecular wt: 90.18; mp: -116; bp: 98; d: 0.8365; vap. d: 3.1; slightly soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The odor threshold for butanethiol is reported ranging from 0.001 to 0.0001 ppm; the odor is readily noticeable at 0.1 to 1 ppm (ref. 4). This compound occurs infamously in skunk oil (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

Odor is the most significant characteristic of n-butanethiol.

Toxicity is believed to be slight and similar to the toxicity of the other thiols. The lowest concentration to have a toxic effect on a human is 10 mg/m^3 for 3 hours (ref. 2).

LC_{50} (inhalation, rat): 4,020 ppm for 4 hrs.

LD_{50} (oral, rat): 1,500 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 1.5 mg/m^3 (0.5 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.5×10^3 $\mu g/m^3$ (0.5 ppm)
Water, Health: $15 \times 1.5 \times 10^3 = 2.25 \times 10^4$ $\mu g/\ell$
Land, Health: $0.002 \times 2.25 \times 10^4 = 45$ $\mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 1.5/420 = 3.6$ $\mu g/m^3$
$EPC_{AH1a} = 0.5/420 = 0.001$ ppm
$EPC_{WH1} = 15 \times 3.6 = 54$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 1.5 = 21$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 21 = 0.04$ $\mu g/g$

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.5E3 (0.5)		3.6 (0.001)		
Water, $\mu g/l$ (ppm Wt)			2.25E4		21		
Land, $\mu g/g$ (ppm Wt)			4.5E1		0.04		

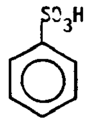
*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			3.6 (0.001)		
Water, $\mu g/l$ (ppm Wt)			21		
Land, $\mu g/g$ (ppm Wt)			0.04		

CATEGORY: 14A

WLN: WSQR

STRUCTURE:



BENZENESULFONIC ACID: $C_6H_6SO_3$ (phenylsulfonic acid).
Benzenesulfonic acid crystallizes as colorless plates from water.

PROPERTIES:

Molecular wt: 158; mp: 43-44, 65-66 (anhydrous); very soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Sulfonic acids are highly polar compounds. They are strong acids, being completely ionized in aqueous solutions. They may be fused with alkali to sulfonates which are hydrolyzed in acid to phenols.

Benzenesulfonic acid is decomposed by heat (100-175° C) to benzene and sulfuric acid.

TOXIC PROPERTIES, HEALTH EFFECTS:

Benzenesulfonic acid is a strong acid. Contact of benzenesulfonic acid with the skin may result in irritation or burns. It is very irritating to skin, eyes, and mucous membranes (ref. 24).

LD_{50} (oral, rat): 890 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 890 = 4.0 \times 10^4$ μg/m^3

Water, Health: $15 \times 4.0 \times 10^4 = 6.0 \times 10^5$ μg/ℓ

Land, Health: $0.002 \times 6.0 \times 10^5 = 1.2 \times 10^3$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 890 = 95$ μg/m^3

$EPC_{AH3} = 0.081 \times 890 = 72$ μg/m^3

$EPC_{WH1} = 15 \times 72 = 1{,}080$ μg/ℓ

$EPC_{WH2} = 0.4 \times 890 = 356$ μg/ℓ

$EPC_{LH} = 0.002 \times 356 = 0.7$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.0E4		72		
Water, $\mu g/l$ (ppm Wt)			6.0E5		356		
Land, $\mu g/g$ (ppm Wt)			1.2E3		0.7		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

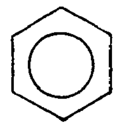
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			72		
Water, $\mu g/l$ (ppm Wt)			356		
Land, $\mu g/g$ (ppm Wt)			0.7		

CATEGORY: 15

WLN: R

BENZENE: C_6H_6 (benzol, phenylhydride, phene).
A clear, colorless liquid.

STRUCTURE:



PROPERTIES:

Molecular wt: 78.11; mp: 5.5; bp: 80.1;
d: 0.87865_4^{20}; vap. press: 100 mm at 26.1° C; vap. d: 2.77;
solubility in water: 1,780 mg/ℓ at 25° (ref. 52); soluble in tissue lipids.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Benzene occurs in straight-run petroleum distillates and in coal-tar distillates. Rural background for benzene is reported as 0.1 ppbc (ref. 1). This is equivalent to 0.017 ppb or 0.054 $\mu g/m^3$. The odor recognition level is 10.5 to 210 mg/m^3 (ref. 3). Benzene participates to a very limited degree in photooxidation reactions (ref. 3). Benzene has been identified in at least one drinking water supply in the United States in concentrations as high as 10 µg/ℓ (ref. 13). There is a strong indication that plants may perform a major role in the degradation and synthesis of benzene in the environment (ref. 52).

TOXIC PROPERTIES, HEALTH EFFECTS:

Benzene is an acute and chronic poison. It is absorbed through the skin, but most often poisoning occurs through inhalation. The rate of absorption of benzene through the skin has been reported to be 0.4 $mg/cm^2/hr$ (ref. 53). It is estimated that 50 percent to 70 percent of benzene inhaled may be absorbed through the lungs (ref. 53). In acute poisoning, benzene acts as a narcotic. Chronic poisoning is characterized by damage to the blood-forming tissues and changes in body organs, including the lymph nodes (ref. 54). Inhalation of 210 ppm has resulted in blood disorders for exposed workers (refs. 4,2,9). Benzene can induce chromosomal aberrations in humans (ref. 54).

Benzene is listed in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 7222. Inhalation of 2,100 mg/m^3 for 4 years has resulted in cancer in an exposed worker, and large doses of benzene painted repeatedly on the skin of mice have resulted in some incidence of skin carcinomas. TD_{Lo}'s associated with these tests are extremely high and are probably not indicative of the true carcinogenic potential of benzene. An epidemiological study conducted by NIOSH indicates that the incidence of leukemia in workers exposed to benzene is at least five times the expected incidence (ref. 54).

Benzene is toxic to aquatic life: 96 hour - TLm: 10-100 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV: 30 mg/m^3 (10 ppm). ACGIH classified benzene as an Occupational Substance Suspected of Oncogenic Potential for workers. (Evidence linking benzene to leukemia was limited at the time the TLV was established.)
Benzene appears on EPA Consent Decree List with an assigned priority of 1.
Benzene is the subject of a NIOSH Criteria Document (ref. 55).
The Labor Department has issued emergency temporary standards limiting worker exposure to benzene to 1 ppm as an 8-hour time-weighted average concentration, with a ceiling level of 5 ppm for any 15-minute period during the 8-hour day (ref. 54). The emergency standard is based on conclusive evidence that exposure to benzene presents a leukemia hazard (ref. 54). The standard also prohibits repeated or prolonged skin exposure to liquid benzene.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.0×10^3 $\mu g/m^3$
Water, Health: $15 \times 3.0 \times 10^3 = 4.5 \times 10^4$ µg/ℓ
Land, Health: $0.002 \times 4.5 \times 10^4 = 90$ µg/g

Air, Ecology:
Water, Ecology: $100 \times 10 = 1.0 \times 10^3$ µg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^3 = 2$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 30/420 = 71.4$ $\mu g/m^3$
$EPC_{AH1a} = 10/420 = 0.024$ ppm
$EPC_{WH1} = 15 \times 71.4 = 1{,}071$ µg/ℓ
$EPC_{WH2} = 13.8 \times 30 = 414$ µg/ℓ
$EPC_{LH} = 0.002 \times 414 = 0.83$ µg/g
$EPC_{AC1} = 10^3 \times 3/420 = 7.1$ $\mu g/m^3$
$EPC_{WC} = 15 \times 7.1 = 107$ µg/ℓ
$EPC_{LC} = 0.002 \times 107 = 0.21$ µg/g

$EPC_{WE1} = 50 \times 10 = 500$ µg/ℓ
$EPC_{LE} = 0.002 \times 500 = 1$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			3.0E3		7.1		0.054
Water, μg/l (ppm Wt)			4.5E4	1.0E3	107	500	10†
Land, μg/g (ppm Wt)			9.0E1	2.0E0	0.21	1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			71.4 (0.024)		7.1
Water, μg/l (ppm Wt)			414	500	107
Land, μg/g (ppm Wt)			0.83	1	0.21

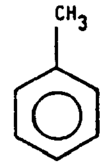
†Maximum concentration identified in drinking water.

CATEGORY: 15

WLN: IR

TOLUENE: C_7H_8 (methylbenzene, toluol, phenylmethane).
A clear, colorless liquid; sweet, pungent, benzene-like odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 92.13; mp: -96; bp: 110.6, $14.5^{14.5}$; d: 0.8669^{20}; insoluble in water; vap. press.: 36.7 mm at 30° C; vap. d: 3.14.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Toluene is a constituent of coal tar; it is generally associated with benzene and xylene. Rural concentration in air is reported as 3.0 to 18.2 ppbc (0.4 to 2.6 ppb, or 1.5 to 9.8 $\mu g/m^3$) (ref. 1).

Odor recognition level is reported as 1.03 to 140 $\mu g/m^3$ (0.27 to 37 ppb) (ref. 3) and the odor threshold level, 2.14 ppm (8 mg/m^3) (ref. 29). Toluene participates to a limited extent in photooxidation reactions (ref. 3).

Toluene has been found in samples of U.S. drinking water supplies in concentrations of 11 $\mu g/\ell$ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Acute poisoning may result from exposure to high concentrations of toluene; a narcotic effect is produced. Human death has resulted from exposure to 10,000 ppm (ref. 4). Toluene is more acutely toxic than benzene; however, severe blood disorders of the type associated with benzene are not reported. Inhalation of 100 ppm has resulted in psychological effects and 200 ppm has affected the central nervous system in humans (ref. 2). Irritative effects to eyes, mucous membranes, and the upper respiratory tract have resulted from exposure to 200 to 500 ppm (ref. 56). Toluene may be absorbed through the skin as well as by inhalation (ref. 56), although the inhalation route is far more important. There is evidence to indicate that at equilibrium, the average toluene concentration per liter of blood is 2.4 mg for each 100 ppm toluene in the environmental air (ref. 57). The biological half-life for toluene is reported to be 0.083 days (ref. 20).

LD_{50} (oral, rat): 5,000 mg/kg. LC_{Lo} (inhalation, rat): 4,000 ppm for 4 hours.

Aquatic toxicity: TLm 96: 100-10 ppm (ref. 2). Concentrations of 0.25 mg/ℓ can cause tainting of fish flesh (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 375 mg/m^3 (100 ppm). Toluene is on EPA's Consent Decree Priority III List.

Toluene is the subject of a NIOSH Criteria Document. The NIOSH recommendation for occupational exposure to toluene is 100 ppm as an 8-hour per work day time-weighted average. A ceiling value of 200 ppm is recommended (ref. 56).

Toluene is on the First Priority Chemicals List of Chemical Industry Institute of Toxicology.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.75×10^5 $\mu g/m^3$ (100 ppm)
Water, Health: $15 \times 3.75 \times 10^5 = 5.6 \times 10^6$ $\mu g/\ell$
Land, Health: $0.002 \times 5.6 \times 10^6 = 1.1 \times 10^4$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 10 = 1 \times 10^3$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1 \times 10^3 = 2$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 375/420 = 893$ $\mu g/m^3$
$EPC_{AH1a} = 100/420 = 0.24$ppm
$EPC_{WH1} = 15 \times 893 = 13{,}400$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 375 = 5{,}200$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 5{,}200 = 10$ $\mu g/g$

$EPC_{WE1} = 50 \times 10 = 500$ $\mu g/\ell$
$EPC_{WE2} = 250$ $\mu g/\ell$ (to prevent tainting)
$EPC_{LE} = 0.002 \times 250 = 0.5$ $\mu g/g$

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.75E5 (100)		893 (0.24)		1.5 to 9.8
Water, $\mu g/l$ (ppm Wt)			5.6E6	1.0E3	5,200	250	11†
Land, $\mu g/g$ (ppm Wt)			1.1E4	2.0E0	10	0.5	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			893 (0.24)		
Water, $\mu g/l$ (ppm Wt)			5,200	250	
Land, $\mu g/g$ (ppm Wt)			10	0.5	

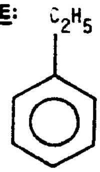
†Drinking water supplies.

CATEGORY: 15

WLN: 2R

ETHYL BENZENE: $C_6H_5C_2H_5$ (ethyl benzol, phenylethane).
A colorless liquid; aromatic odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 106.16; mp: -94.9; bp: 136.2; d: 0.8669;
vap. press.: 10 mm at 25.9°; vap. d: 3.66; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Rural concentration in air is reported as 0.5 to 1.6 ppbc (ref. 1). This is equivalent to 0.06-0.20 ppb = 0.3-0.87 $\mu g/m^3$. Urban concentrations as high as 111 ppbc (13.9 ppb, or 60 $\mu g/m^3$) have been reported (ref. 1).

TOXIC PROPERTIES, HEALTH EFFECTS:

Ethyl benzene is an irritant to mucous membranes, skin, and eyes; and a narcotic in high concentrations. It is the most severe skin irritant of the benzene series. A concentration of 200 ppm causes eye irritation and gives warning of dangerous concentrations (refs. 4, 57). A concentration of 100 ppm for 8 hours caused irritative effects in a human (ref. 2). It is absorbed through the skin as well as through the lungs. No chronic effects of exposure are reported.

LD_{50} (oral, rat): 3,500 mg/kg.
LC_{Lo} (inhalation, rat): 4,000 ppm for 4 hours.
Aquatic toxicity: TLm 96: 100-10 ppm (ref. 2).
Concentrations of: <0.25 mg/ℓ can cause tainting of fish flesh (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 435 mg/m^3 (100 ppm).
On EPA's Consent Decree Priority III List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 4.35×10^5 $\mu g/m^3$ (100 ppm)
Water, Health: $15 \times 4.35 \times 10^5 = 6.5 \times 10^6$ $\mu g/\ell$
Land, Health: $0.002 \times 6.5 \times 10^6 = 1.3 \times 10^4$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 10 = 1.0 \times 10^3$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^3 = 2$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 435/420 = 1{,}040$ $\mu g/m^3$
$EPC_{AH1a} = 100/420 = 0.24$ ppm
$EPC_{WH1} = 15 \times 1{,}040 = 15{,}600$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 435 = 6{,}000$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 6{,}000 = 12$ $\mu g/g$

$EPC_{WE1} = 50 \times 10 = 500$ $\mu g/\ell$
$EPC_{WE2} = 250$ $\mu g/\ell$ (to prevent tainting)
$EPC_{LE} = 0.002 \times 250 = 0.5$ $\mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.35E5 (100)		1,040 (0.24)		0.3 to 0.87
Water, $\mu g/l$ (ppm Wt)			6.5E6	1.0E3	6,000	250	
Land, $\mu g/g$ (ppm Wt)			1.3E4	2.0E0	12	0.5	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

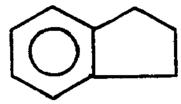
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			1,040 (0.24)		
Water, $\mu g/l$ (ppm Wt)			6,000	250	
Land, $\mu g/g$ (ppm Wt)			12	0.5	

CATEGORY: 15

WLN: L56T&J

INDAN: C_9H_{10} (hydrindene).
A colorless liquid.

STRUCTURE:



PROPERTIES:

Molecular wt: 118.19; mp: -51.4; bp: 176; d: 0.964;
insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Indan is present in coal tar.

TOXIC PROPERTIES, HEALTH EFFECTS:

LD_{LO} (oral, rat): 5,000 mg/kg.

Indan may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59).

Indan is not included in the compounds tested thus far for carcinogenic activity (ref. 60).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 5{,}000 = 2.25 \times 10^5$ μg/m³

Water, Health: $15 \times 2.25 \times 10^5 = 3.4 \times 10^6$ μg/ℓ

Land, Health: $0.002 \times 3.4 \times 10^6 = 6.8 \times 10^3$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 5{,}000 = 535$ μg/m³

$EPC_{AH3} = 0.081 \times 5{,}000 = 405$ μg/m³

$EPC_{WH1} = 15 \times 4.05 \times 10^3 = 6{,}000$ μg/ℓ

$EPC_{WH2} = 0.4 \times 5{,}000 = 2{,}000$ μg/ℓ

$EPC_{LH} = 0.002 \times 2{,}000 = 4$ μg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.25E5		405		
Water, $\mu g/l$ (ppm Wt)			3.4E6		2,000		
Land, $\mu g/g$ (ppm Wt)			6.8E3		4		

*To be multiplied by dilution factor

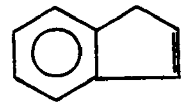
	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			405		
Water, $\mu g/l$ (ppm Wt)			2,000		
Land, $\mu g/g$ (ppm Wt)			4		

CATEGORY: 15

WLN: L56 BHJ

INDENE: C_9H_8 (indonaphthene).
A colorless liquid.

STRUCTURE:



PROPERTIES:

Molecular wt: 116.2; mp: -1.8; bp: 181.6; d: 0.996;
insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Indene is found in coal tar.

TOXIC PROPERTIES, HEALTH EFFECTS:

LD_{Lo} (subcutaneous, rat): 1,000 mg/kg.

Serious systemic responses may result from exposure to high concentrations of indene absorbed primarily through inhalation (ref. 4).

The epoxide is considered inactive as a skin carcinogen in animals (ref. 59).

Indene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 45 mg/m^3 (10 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 4.5×10^4 $\mu g/m^3$ (10 ppm)
Water, Health: $15 \times 4.5 \times 10^4 = 6.75 \times 10^5$ $\mu g/\ell$
Land, Health: $0.002 \times 6.75 \times 10^5 = 1.35$ $\mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 45/420 = 107$ $\mu g/m^3$
$EPC_{AH1a} = 10/420 = 0.024$ ppm
$EPC_{WH1} = 15 \times 107 = 1,605$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 45 = 621$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 621 = 1.2$ $\mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.5E4 (10)		107 (0.024)		
Water, $\mu g/l$ (ppm Wt)			6.75E5		621		
Land, $\mu g/g$ (ppm Wt)			1.4E0		1.2		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

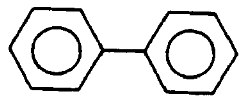
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			107 (0.024)		
Water, $\mu g/l$ (ppm Wt)			621		
Land, $\mu g/g$ (ppm Wt)			1.2		

CATEGORY: 15

WLN: RR

BIPHENYL: $C_{12}H_{10}$ (bibenzene, diphenyl, phenylbenzene, PH).
White or colorless scales; pleasant odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 154.2; mp: 71; bp: 255.9; d: 0.8660^{20}, 1.9896^{77}; vap.d: 5.31; vap. press: 1 mm at 70.6°; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Biphenyl is produced by thermal dehydrogenation of benzene (ref. 57).

TOXIC PROPERTIES, HEALTH EFFECTS:

Reported effects resulting from exposure to biphenyl include irritation and injury to respiratory passages; no chronic effects are documented (ref. 4). Exposure by inhalation to 4,400 $\mu g/m^3$ caused irritative effects in a human (ref. 2).

LD_{50} (oral, rat): 3,280 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 1 mg/m^3 (0.2 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.0×10^3 $\mu g/m^3$ (0.2 ppm)
Water, Health: $15 \times 1.0 \times 10^3 = 1.5 \times 10^4$ $\mu g/\ell$
Land, Health: $0.002 \times 1.5 \times 10^4 = 30$ $\mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 1/420 = 2.4$ $\mu g/m^3$
$EPC_{AH1a} = 0.2/420 = 0.0005$ ppm
$EPC_{WH1} = 15 \times 2.4 = 36$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 1 = 13.8$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 13.8 = 0.03$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m^3 (ppm Vol)			1.0E3 (0.2)		2.4 (5.0E-4)		
Water, μg/l (ppm Wt)			1.5E4		13.8		
Land, μg/g (ppm Wt)			3.0E1		0.03		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m^3 (ppm Vol)			2.4 (0.0005)		
Water, μg/l (ppm Wt)			13.8		
Land, μg/g (ppm Wt)			0.03		

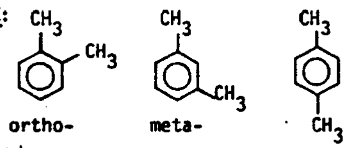
CATEGORY: 15

WLN: 1RB; 1RC; 1RD

XYLENES: C_8H_{10} (dimethylbenzene, xylol).

A mobile, flammable liquid.
m-xylene: colorless liquid.
o-xylene: colorless liquid.
p-xylene: colorless plates or prisms at low temperature.

STRUCTURE:



ortho- meta- para-

PROPERTIES:

	Mol. wt	d_4^{20}	mp	bp	Water Solubility	Vap. d	Vap. press
m-xylene	106.2	0.864	-47.4	139.3	insoluble	3.66	10 mm at 28.3°
o-xylene	106.2	0.880	-25	144	"	3.66	10 mm at 32.1°
p-xylene	106.2	0.861	13-14	137-138	"	3.66	10 mm at 27.3°

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Xylenes include meta, ortho, and para structures. The meta isomer predominates in mixtures. The odor threshold in air for p-xylene is 0.47 ppm (2 mg/m^3) (ref. 29). Rural background concentrations are reported as follows (ref. 1):

	Rural Concentration
m-xylene	1.1-9.7 ppbc (0.14-1.2 ppb; 0.6-5.2 μg/m^3)
o-xylene	3.4-7.0 ppbc (0.43-0.88 ppb; 1.9-3.8 μg/m^3)
p-xylene	0.5-1.6 ppbc (0.06-0.2 ppb; 0.3-0.9 μg/m^3)

All three isomers have been found in samples of U.S. drinking water supplies in concentrations less than 5 μg/ℓ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Xylenes are absorbed through skin as well as by inhalation (ref. 9). They may be narcotic in high concentrations. Chronic toxicity is not well known, but xylenes are considered less toxic than benzene (ref. 24). Effects of exposure to xylenes may be similar to effects from toluene but with a higher degree of toxicity (ref. 4). Concentrations of 200 ppm is irritating to eyes, nose, and throat (refs. 4, 57). Since occurrence of xylenes is generally associated with benzene, the specific toxic potential of xylenes is difficult to isolate.

	LD_{50} (oral, rat)	LC_{Lo} (inhalation, rat)	LC_{Lo} (inhalation, mouse)	Aquatic toxicity
m-xylene	5,000 mg/kg	8,000 ppm/4 hours	--	--
o-xylene	5,000 mg/kg	--	6,920 ppm	TLm96: 100-10 ppm
p-xylene	5,000 mg/kg	--	3,460 ppm	TLm96: 100-10 ppm
xylene (mixture)	4,300 mg/kg	6,700 ppm/4 hours	--	TLm96: 100-10 ppm

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 435 mg/m^3 (100 ppm).

Xylene is the subject of a NIOSH criteria document. The NIOSH recommendation for occupational exposure to xylene is 100 ppm as a 10-hour-workday, time-weighted average. A ceiling of 200 ppm is recommended. (Xylene as used in the document refers to any one of a combination of the isomers of xylene) (ref. 61).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 4.35×10^5 μg/m^3 (100 ppm)
Water, Health: $15 \times 4.35 \times 10^5 = 6.5 \times 10^6$ μg/ℓ
Land, Health: $0.002 \times 6.5 \times 10^6 = 1.3 \times 10^4$ μg/g

Air, Ecology:
Water, Ecology: $100 \times 10 = 1.0 \times 10^3$ μg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^3 = 2$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 435/420 = 1{,}040$ μg/m^3
$EPC_{AH1a} = 100/420 = 0.24$ ppm
$EPC_{WH1} = 15 \times 1{,}040 = 15{,}600$ μg/ℓ
$EPC_{WH2} = 13.8 \times 435 = 6{,}000$ μg/ℓ
$EPC_{LH} = 0.002 \times 6{,}000 = 12$ μg/g

$EPC_{WE1} = 50 \times 10 = 500$ μg/ℓ
$EPC_{WE2} = 250$ μg/ℓ (To prevent tainting)
$EPC_{LE} = 0.002 \times 250 = 0.5$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.35E5 (100)		1,040 (0.24)		0.3 to 5.2
Water, $\mu g/l$ (ppm Wt)			6.5E6	1.0E3	6,000	250	<5†
Land, $\mu g/g$ (ppm Wt)			1.3E4	2.0E0	12	0.5	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			1,040 (0.24)		
Water, $\mu g/l$ (ppm Wt)			6,000	250	
Land, $\mu g/g$ (ppm Wt)			12	0.5	

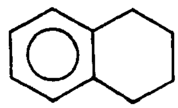
†Drinking water supplies.

CATEGORY: 15

WLN: L66+TJ

TETRAHYDRONAPHTHALENE: $C_{10}H_{12}$ (tetralin, tetraline).
A colorless liquid; menthol odor.

STRUCTURE:



PROPERTIES:

Molecular Wt.: 132.2; mp: -35.79; bp: 207.57, 79.36^{10}; d: 0.9707; vap. press: 1 mm at 38°; vap. d: 4.55; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Tetrahydronaphthalene is produced by the catalytic hydrogenation of naphthalene (ref. 57).

TOXIC PROPERTIES, HEALTH EFFECTS:

Tetrahydronaphthalene is an irritant in low concentrations. Narcotic effects result from exposure to high concentrations (ref. 9).

LD_{50} (oral, rat): 2,860 mg/kg.
LC_{Lo} (inhalation, guinea pig): 275 ppm for 8 hours for 17 days.
Aquatic toxicity: TLm96: 100-10 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 2860 = 1.3 \times 10^5$ μg/m³
Water, Health: $15 \times 1.3 \times 10^5 = 2.0 \times 10^6$ μg/ℓ
Land, Health: $0.002 \times 2.0 \times 10^6 = 4.0 \times 10^3$ μg/g

Air, Ecology:
Water, Ecology: $100 \times 10 = 1.0 \times 10^3$ μg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^3 = 2$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 2,860 = 306$ μg/m³
$EPC_{AH3} = 0.081 \times 2,860 = 232$ μg/m³
$EPC_{WH1} = 15 \times 232 = 3,480$ μg/ℓ
$EPC_{WH2} = 0.4 \times 2,860 = 1,140$ μg/ℓ
$EPC_{LH} = 0.002 \times 1,140 = 2.3$ μg/g

$EPC_{WE1} = 50 \times 10 = 500$ μg/ℓ
$EPC_{LE} = 0.002 \times 500 = 1$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.3E5		232		
Water, $\mu g/l$ (ppm Wt)			2.0E6	1.0E3	1,140	500	
Land, $\mu g/g$ (ppm Wt)			4.0E3	2.0E0	2.3	1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			232		
Water, $\mu g/l$ (ppm Wt)			1,140	500	
Land, $\mu g/g$ (ppm Wt)			2.3	1	

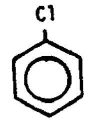
CATEGORY: 16A

WLN: GR

CHLOROBENZENE: C_6H_5Cl (phenyl chloride).

A colorless liquid, faint, not unpleasant odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 112.56; mp: -45.6; bp: 131-132;
d: 1.1058; vap. d: 3.88; vap. press: 10 mm at 22°; solubility in water: 49 mg/100 ml at 20°C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Odor threshold level for chlorobenzene is reported as 0.21 ppm (ref. 29). Chlorobenzene has been found in samples of U.S. drinking water supplies at levels of less than 5 μg/ℓ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Chlorobenzene is a central nervous system depressant and may affect the liver and kidneys (ref. 62). It has only slight irritant qualities (ref. 9).

A narcotic effect was observed when animals were exposed to concentrations of chlorobenzene above 1,200 ppm (ref. 4). Little information is available on human effects from repeated exposure to subnarcotic concentrations (ref. 9).

LD_{50} (oral, rat): 2,910 mg/kg.

Aquatic toxicity: TLm96: 100-1 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 350 mg/m^3 (75 ppm).
Chlorobenzene is on EPA Consent Decree Priority 2 List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.50×10^5 μg/m^3 (75 ppm)
Water, Health: $15 \times 3.5 \times 10^5 = 5.25 \times 10^6$ μg/ℓ
Land, Health: $0.002 \times 5.25 \times 10^6 = 1.05 \times 10^4$ μg/g

Air, Ecology:
Water, Ecology: $100 \times 1 = 100$ μg/ℓ
Land, Ecology: $0.002 \times 100 = 0.2$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 350/420 = 830$ μg/m^3
$EPC_{AH1a} = 75/420 = 0.18$ ppm
$EPC_{WH1} = 15 \times 830 = 12,500$ μg/ℓ
$EPC_{WH2} = 13.8 \times 350 = 4,830$ μg/ℓ
$EPC_{LH} = 0.002 \times 4,830 = 9.7$ μg/g

$EPC_{WE1} = 50 \times 1 = 50$ μg/ℓ
$EPC_{LE} = 0.002 \times 50 = 0.1$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.50E5 (75)		830 (0.18)	–	
Water, $\mu g/l$ (ppm Wt)			5.25E6	1.0E2	4,830	50	5†
Land, $\mu g/g$ (ppm Wt)			1.05E4	2.0E-1	9.7	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			830 (0.18)		
Water, $\mu g/l$ (ppm Wt)			4,830	50	
Land, $\mu g/g$ (ppm Wt)			9.7	0.1	

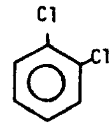
†Drinking water supplies.

CATEGORY: 16A

WLN: GR BG

1,2-DICHLOROBENZENE: $C_6H_4Cl_2$, (o-dichlorobenzene). A colorless liquid.

STRUCTURE:



PROPERTIES:

Molecular wt: 147.01; mp: -17; bp: 180; d: 1.3048; Vap. d: 5.07; vap. press: 1.56 mm at 25°; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The odor of o-dichlorobenzene may be detected at 50 ppm (300 mg/m^3) (ref. 62).

o-Dichlorobenzene has been found in samples of U.S. drinking water supplies in a concentration of 1 μg/ℓ (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Toxicity of 1,2-Dichlorobenzene is similar to that of other aromatic chloro compounds; however, the o-isomer of dichlorobenzene is somewhat more toxic than the m- or p-forms. It causes central nervous system depression, can injure the liver and kidneys, and is irritating to skin and mucous membranes (ref. 9). Exposure to concentrations above 90 ppm affected test animals (ref. 4).

LC_{Lo} (inhalation, rat): 707 ppm for 7 hours.

LD_{Lo} (oral, guinea pig): 2,000 mg/kg.

Aquatic toxicity: 96-hr TLm (for mixed dichlorobenzene isomers): 10 to < 1 ppm (ref. 2).

A concentration of 0.25 mg/ℓ of 1,2-Dichlorobenzene is reported to cause tainting of fish flesh (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 300 mg/m^3 (50 ppm).

On EPA Consent Decree Priority I List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.0×10^5 $\mu g/m^3$ (50 ppm)

Water, Health: $15 \times 3 \times 10^5 = 4.5 \times 10^6$ μg/ℓ

Land, Health: $0.002 \times 4.5 \times 10^6 = 9.0 \times 10^3$ μg/g

Air, Ecology:

Water, Ecology: $100 \times 1 = 100$ μg/ℓ

Land, Ecology: $0.002 \times 100 = 0.2$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 300/420 = 714$ $\mu g/m^3$

$EPC_{AH1a} = 50/420 = 0.12$ ppm

$EPC_{WH1} = 15 \times 714 = 10{,}700$ μg/ℓ

$EPC_{WH2} = 13.8 \times 300 = 4{,}140$ μg/ℓ

$EPC_{LH} = 0.002 \times 4{,}140 = 8.3$ μg/g

$EPC_{WE1} = 50 \times 1 = 50$ μg/ℓ

$EPC_{WE2} = 250$ μg/ℓ

$EPC_{LE} = 0.002 \times 50 = 0.1$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.0E5 (50)		714 (0.12)		
Water, $\mu g/l$ (ppm Wt)			4.5E6	1.0E2	4,140	50	1†
Land, $\mu g/g$ (ppm Wt)			9.0E3	2.0E-1	8.3	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			714 (0.12)		
Water, $\mu g/l$ (ppm Wt)			4,140	50	
Land, $\mu g/g$ (ppm Wt)			8.3	0.1	

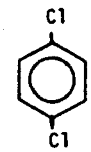
†Drinking water supplies.

CATEGORY: 16A

WLN: GR DG

1,4-DICHLOROBENZENE: $C_6H_4Cl_2$ (p-Dichlorobenzene).
Volatile crystals with characteristic, penetrating odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 147.01; mp: 53; bp: 174; d: 1.2884; vap. d: 5.07; vap. press: 10 mm at 55°; insoluble in water; sublimes at ordinary temperatures.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The odor threshold level is 15-30 ppm (90-180 mg/m^3) in air (ref. 62). 1,4-Dichlorobenzene has been found in a concentration of 1 µg/ℓ in samples of U.S. drinking water supplies (ref. 13).

TOXIC PROPERTIES, HEALTH EFFECTS:

Vapors of 1,4-dichlorobenzene can cause irritation to skin, throat, and eyes; repeated exposure to high concentrations may cause liver injury and central nervous system depression (refs. 24, 62). Ingestion of 300 mg/kg by a human has resulted in unspecified toxic effects (ref. 2).

LD_{50} (oral, rat): 500 mg/kg.

Aquatic toxicity: 96-hr. TLm for mixed dichlorobenzene isomers: 10 to < 1 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 450 mg/m^3 (75 ppm).
On EPA Consent Decree Priority I List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 4.5×10^5 µg/m^3 (75 ppm)
Water, Health: $15 \times 4.5 \times 10^5 = 6.75 \times 10^6$ µg/ℓ
Land, Health: $0.002 \times 6.75 \times 10^6 = 1.35 \times 10^4$ µg/g

Air, Ecology:
Water, Ecology: $100 \times 1 = 100$ µg/ℓ
Land, Ecology: $0.002 \times 100 = 0.2$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 450/420 = 1{,}070$ µg/m^3
$EPC_{AH1a} = 75/420 = 0.18$ ppm
$EPC_{WH1} = 15 \times 1{,}070 = 16{,}100$ µg/ℓ
$EPC_{WH2} = 13.8 \times 450 = 6{,}210$ µg/ℓ
$EPC_{LH} = 0.002 \times 6{,}210 = 12$ µg/g

$EPC_{WE1} = 50 \times 1 = 50$ µg/ℓ
$EPC_{LE} = 0.002 \times 50 = 0.1$ µg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.5E5 (75)		1,070 (0.18)	-	
Water, $\mu g/l$ (ppm Wt)			6.75E6	1.0E2	6,210	50	1†
Land, $\mu g/g$ (ppm Wt)			1.35E4	2.0E-1	12	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			1,070 (0.18)		
Water, $\mu g/l$ (ppm Wt)			6,210	50	
Land, $\mu g/g$ (ppm Wt)			12	0.1	

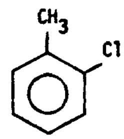
†Drinking water supplies.

CATEGORY: 16A

WLN:

2-CHLOROTOLUENE: C_7H_7Cl (o-chlorotoluene, 1 methyl-2-chlorobenzene, o-tolyl chloride).
A colorless liquid.

STRUCTURE:



PROPERTIES:

Molecular wt: 126.59; mp: -35.1; bp: 159.15; d: 1.0825; vap. press: 10 mm at 46.2°; slightly soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

TOXIC PROPERTIES, HEALTH EFFECTS:

Toxicity of 2-Chlorotoluene is similar to that of other aromatic chloro compounds. Animal exposure to concentrations above 1,000 ppm has resulted in narcotic effects (see ref. 4).

LD_{50} (oral, rat): > 1,600 mg/kg (ref. 4).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 250 mg/m^3 (50 ppm) based on analogy with other chlorinated benzenes.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2.5×10^5 $\mu g/m^3$ (50 ppm)
Water, Health: $15 \times 2.5 \times 10^5 = 3.75 \times 10^6$ $\mu g/\ell$
Land, Health: $0.002 \times 3.75 \times 10^6 = 7.5 \times 10^3$ $\mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 250/420 = 600$ $\mu g/m^3$
$EPC_{AH1a} = 50/420 = 0.12$ ppm
$EPC_{WH1} = 15 \times 600 = 9{,}000$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 250 = 3{,}450$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 3{,}450 = 7$ $\mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.5E5 (50)		600 (0.12)		
Water, $\mu g/l$ (ppm Wt)			3.75E6		3,450		
Land, $\mu g/g$ (ppm Wt)			7.5E3		7		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

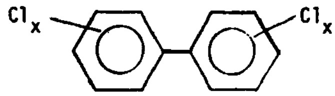
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			600 (0.12)		
Water, $\mu g/l$ (ppm Wt)			3,450		
Land, $\mu g/g$ (ppm Wt)			7		

CATEGORY: 16A

WLN:

(PCB's) POLYCHLORINATED BIPHENYLS: $C_{12}Cl_n$ (aroclors). Depending on the degree of halogenation, polychlorinated biphenyls vary from colorless, oily liquids to black resins.

STRUCTURE:



PROPERTIES:

bp: 278-475; slightly soluble in water; 100 to 1,000 μg/ℓ (ref. 28). The density, boiling point, and melting point increase with chlorine content (ref. 33); soluble in lipids (ref. 33).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Polychlorinated biphenyls are produced by the chlorination of biphenyl. They are remarkably stable and resist attack by water, acids, and bases. They are not easily biodegraded (ref. 29). Biphenyls may have 1 to 10 attached chlorine atoms, making possible over 200 compounds (ref. 28). Concentrations of PCB's ranging from 2.0-2.8 μg/ℓ in the Milwaukee River have been reported; concentration in Lake Michigan is reported as 0.01 μg/ℓ (ref. 33).

It is estimated that 41 to 45 percent of the general population of the United States have PCB levels of 1.0 mg/kg or higher in adipose tissue (ref. 28). PCB's are not believed to be naturally occurring compounds, but are manufactured as mixtures containing specified amounts of chlorine. Such mixtures are referred to by the trademark name Aroclors followed by a four-digit number; the last two digits of the number indicate the percentage of chlorine.

TOXIC PROPERTIES, HEALTH EFFECTS:

Exposure to PCB's can cause acne, respiratory tract irritation and liver injury (ref. 4). PCB's are considered to be cumulative poisons, and they may be absorbed through the skin (ref. 4). Workers exposed to 0.1 mg/m^3 of the vapors of Aroclor 1242 experienced effects (ref. 4). Animal studies indicate that acute toxicity of the PCB's varies with the specific mixture.

Mixture	LD_{50} (oral, rat) in mg/kg	Mixture	LD_{50} (oral, rat) in mg/kg	Mixture	LD_{50} (oral, rat) in mg/kg
Aroclor 1221	3,980	Aroclor 1254	1,295	Aroclor 1268	10,900
Aroclor 1232	4,470	Aroclor 1260	1,315	Aroclor 2565	6,310
Aroclor 1242	4,250	Aroclor 1262	11,300	Aroclor 4465	16,000
Aroclor 1248	11,000				

Polychlorinated biphenyls have produced carcinogenic responses in rats and mice. The EPA/NIOSH ordering number for PCB's considered collectively is 4212. The lowest dosage to produce a carcinogenic effect is 1,200 mg/kg. The adjusted ordering number is 3.5.

Aquatic Toxicity: The cumulative potential of PCB's is of great concern in considering toxicity to aquatic life. PCB's at 0.01 μg/ℓ in water have been known to accumulate in fish up to 200,000 times the water concentration. 96-hr TLm's range generally between 1 and 10 μg/ℓ (ref. 33).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV: 0.5 mg/m^3 (for chlorodiphenyls containing 54% chlorine)

TLV: 1 mg/m^3 (for chlorodiphenyls containing 42% chlorine)

Polychlorinated biphenyls are on EPA Consent Decree Priority I List.

Completion of NIOSH criteria document of PCB's is scheduled for 1977 (ref. 2).

EPA 1976 water quality criteria (proposed): 0.001 μg/ℓ for freshwater and marine aquatic life and for consumers thereof (ref. 33).

NAS/NAE 1972 recommended water quality criteria: 0.002 μg/ℓ for protection of aquatic life. PCB concentrations in whole fish should not exceed 0.5 mg/kg of the wet weight for protection of fish-eating birds and mammals (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 500 $\mu g/m^3$

Water, Health: $15 \times 500 = 7.5 \times 10^3$ μg/ℓ

Land, Health: $0.002 \times 7.5 \times 10^3 = 15$ μg/g

Air, Ecology:

Water, Ecology: $5 \times 0.001 = 0.005$ μg/ℓ

Land, Ecology: $0.002 \times 0.005 = 1 \times 10^{-5}$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.5/420 = 1.2\ \mu g/m^3$

$EPC_{WH1} = 15 \times 1.2 = 18$ μg/ℓ

$EPC_{WH2} = 13.8 \times 0.5 = 7$ μg/ℓ

$EPC_{LH} = 0.002 \times 7 = 0.014$ μg/g

$EPC_{WES} = 0.001$ μg/ℓ

$EPC_{LE} = 0.002 \times 0.001 = 2 \times 10^{-6}$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.0E2		1.2		0
Water, $\mu g/l$ (ppm Wt)			7.5E3	5.0E-3	7	0.001	0
Land, $\mu g/g$ (ppm Wt)			1.5E1	1.0E-5	0.014	$2x10^{-6}$	

*To be multiplied by dilution factor

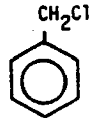
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			1.2		
Water, $\mu g/l$ (ppm Wt)		0.001	7		
Land, $\mu g/g$ (ppm Wt)			0.014	$2x10^{-6}$	

CATEGORY: 16B

WLN: G1R

α-CHLOROTOLUENE: C_7H_7Cl (benzyl chloride).
A colorless liquid with an unpleasant, irritating odor.

STRUCTURE:



PROPERTIES:
Molecular wt: 126.59; mp: -43; bp: 179.3;
d: 1.102^{20}_{20}; vap. d: 4.36; vap. press: 11 mm
at 66°; insoluble in water

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

α-Chlorotoluene decomposes when heated in the presence of iron (ref. 24).
The odor threshold in air for benzyl chloride is reported as 0.047 ppm or 0.24 mg/m^3 (ref. 29).

TOXIC PROPERTIES, HEALTH EFFECTS:

α-Chlorotoluene is highly irritating to eyes and upper respiratory tract. At 16 ppm (83 mg/m^3) for 1 minute, it is intolerable to man (ref. 4).

LD_{50} (oral, rat): 1,231 mg/kg.

LC_{50} (inhalation, rat): 150 ppm for 2 hours.

α-Chlorotoluene appears in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 4101. The lowest dose to induce an oncogenic response is reported as 2100 mg/kg. The adjusted ordering number is 1.9.

Aquatic toxicity: TLm 96: 10-1 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 5 mg/m^3 (1 ppm).
On Second Priority Chemical List of the Chemical Industry Institute of Toxicology (ref. 11).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 5.0×10^3 μg/m^3 (1 ppm)
Water, Health: $15 \times 5 \times 10^3 = 7.5 \times 10^4$ μg/ℓ
Land, Health: $0.002 \times 7.5 \times 10^4 = 1.50$ μg/g

Air, Ecology:
Water, Ecology: $100 \times 1 = 100$ μg/ℓ
Land, Ecology: $0.002 \times 100 = 0.2$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 5/420 = 12$ μg/m^3
$EPC_{AH1a} = 1/420 = 0.002$ ppm
$EPC_{WH1} = 15 \times 12 = 180$ μg/ℓ
$EPC_{WH2} = 13.8 \times 5 = 69$ μg/ℓ
$EPC_{LH} = 0.002 \times 69 = 0.14$ μg/g
$EPC_{AC2} = 10^3/(6 \times 1.9) = 88$ μg/m^3
$EPC_{WC} = 15 \times 88 = 1,320$ μg/ℓ
$EPC_{LC} = 0.002 \times 1,320 = 2.6$ μg/g

$EPC_{WE1} = 50 \times 1 = 50$ μg/ℓ
$EPC_{LE} = 0.002 \times 50 = 0.1$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			5.0E3 (1)		12 (0.002)		
Water, μg/l (ppm Wt)			7.5E4	1.0E2	69	50	
Land, μg/g (ppm Wt)			1.50E0	2.0E-1	0.14	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

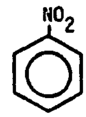
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			12 (0.002)		88
Water, μg/l (ppm Wt)			69	50	1,320
Land, μg/g (ppm Wt)			0.14	0.1	2.6

CATEGORY: 17

WLN: WNR

NITROBENZENE: $C_6H_5NO_2$.

STRUCTURE:



A colorless to pale yellow, oily liquid or bright yellow crystals with odor similar to volatile oil of almonds.

PROPERTIES:

Molecular wt: 123; mp: 6; bp: 210-11; d: 1205; vap. press.: 1mm at 44.4; vap. d: 4.25; soluble in about 500 parts water; volatile with steam.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

All nitro compounds are potentially explosive.

The odor threshold in air for nitrobenzene is 0.0047 ppm or 23 $\mu g/m^3$ (ref. 29).

TOXIC PROPERTIES, HEALTH EFFECTS:

Nitrobenzene is toxic by ingestion and by inhalation. It is readily absorbed through the skin. Effects of exposure include cyanosis, methemoglobinemia, and central nervous system effects (ref. 24).

A woman is reported to have experienced blood effects as a result of ingesting 200 mg/kg of nitrobenzene (ref. 2).

LD_{Lo} (oral, dog): 750 mg/kg.

LD_{Lo} (oral, rabbit): 700 mg/kg.

Aquatic toxicity: TLm 96: 100-10 ppm.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Nitrobenzene is on EPA Consent Decree Priority III List.

TLV = 5 mg/m^3 (1 ppm) skin.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 5.0×10^3 $\mu g/m^3$ (1 ppm)

Water, Health: $15 \times 5.0 \times 10^3 = 7.5 \times 10^4$ $\mu g/\ell$

Land, Health: $0.002 \times 7.5 \times 10^4 = 150$ $\mu g/g$

Air, Ecology:

Water, Ecology: $100 \times 10 = 1.0 \times 10^3$ $\mu g/\ell$

Land, Ecology: $0.002 \times 1.0 \times 10^3 = 2$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 5/420 = 12$ $\mu g/m^3$

$EPC_{AH1a} = 1/420 = 0.002$ ppm

$EPC_{WH1} = 15 \times 12 = 180$ $\mu g/\ell$

$EPC_{WH2} = 13.8 \times 5 = 69$ $\mu g/\ell$

$EPC_{LH} = 0.002 \times 69 = 0.14$ $\mu g/g$

$EPC_{WE1} = 50 \times 10 = 500$ $\mu g/\ell$

$EPC_{LE} = 0.002 \times 500 = 1$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			5.0E3 (1)		12 (0.002)		
Water, μg/l (ppm Wt)			7.5E4	1.0E3	69	500	
Land, μg/g (ppm Wt)			1.5E2	2.0E0	0.14	1	

*To be multiplied by dilution factor

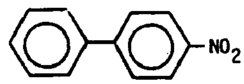
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			12 (0.002)		
Water, μg/l (ppm Wt)			69	500	
Land, μg/g (ppm Wt)			0.14	1	

CATEGORY: 17

WLN: WNR DR

4-NITROBIPHENYL: $C_{12}H_9NO_2$ (p-nitrobiphenyl, 4-nitrodiphenyl). Crystallizes as yellow needles from ethanol.

STRUCTURE:



PROPERTIES:

Molecular wt: 199; mp: 114-114.5; bp: 340 at 760 mm; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

4-Nitrobiphenyl is reduced in the presence of activated iron to the corresponding amine.

All nitro compounds are potentially explosive.

There is evidence that 4-nitrobiphenyl is metabolized in vivo to 4-aminobiphenyl, a highly carcinogenic aromatic amine (ref. 44).

TOXIC PROPERTIES, HEALTH EFFECTS:

LD_{50} (oral, rat): 2,230 mg/kg.

4-Nitrobiphenyl is recognized as one of the more potent human bladder carcinogens (ref. 4). Human bladder cancer has been linked with occupational exposure. In high concentrations (5,500 mg/kg), the compound has produced bladder cancer in dogs (refs. 2,43). The EPA/NIOSH ordering number for 4-nitrobiphenyl is 7212. Considering carcinogenic potential of 4-nitrobiphenyl together with that of its metabolite, 4-aminodiphenyl, the EPA/NIOSH ordering number is 7526, and the lowest dosage resulting in an oncogenic response is 140 mg/kg. The adjusted ordering number for the compounds considered collectively is 54.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

4-nitrodiphenyl is classified by ACGIH as a human carcinogen. No TLV has been assigned; because of the high incidence of cancer, no exposure by any route should be permitted.

4-nitrodiphenyl is the subject of a NIOSH Hazard Review Document (ref. 43).

4-nitrodiphenyl is designated by OSHA as a cancer suspect agent; special precautions for exposed workers are prescribed (ref. 17).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/54 = 1.3 \times 10^3$ µg/m^3	Air, Ecology:
Water, Health: $15 \times 1.3 \times 10^3 = 2.0 \times 10^4$ µg/ℓ	Water, Ecology:
Land, Health: $0.002 \times 2.0 \times 10^4 = 40$ µg/g	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 2,230 = 239$ µg/m^3
$EPC_{AH3} = 0.081 \times 2,230 = 180$ µg/m^3
$EPC_{WH1} = 15 \times 180 = 2,700$ µg/ℓ
$EPC_{WH2} = 0.4 \times 2,230 = 890$ µg/ℓ
$EPC_{LH} = 0.002 \times 890 = 2$ µg/g
$EPC_{AC2} = 10^3/(6 \times 54) = 3$ µg/m^3
$EPC_{WC} = 15 \times 3 = 45$ µg/ℓ
$EPC_{LC} = 0.002 \times 45 = 0.1$ µg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.3E3		3		
Water, $\mu g/l$ (ppm Wt)			2.0E4		45		
Land, $\mu g/g$ (ppm Wt)			4.0E1		0.1		

*To be multiplied by dilution factor

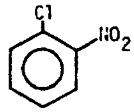
	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			180		3
Water, $\mu g/l$ (ppm Wt)			890		45
Land, $\mu g/g$ (ppm Wt)			2		0.1

CATEGORY: 17

WLN: WNR BG

1-CHLORO-2-NITROBENZENE: $C_6H_4NO_2Cl$ (o-chloronitrobenzene). Yellow crystals.

STRUCTURE:



PROPERTIES:

Molecular wt: 157.6; mp: 32-33; bp: 245-246; d: 1.305; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

All nitro compounds are potentially explosive.

TOXIC PROPERTIES, HEALTH EFFECTS:

Intoxication from 1-chloro-2-nitrobenzene may be serious. It can cause poisoning by the pulmonary route, and its effects are cumulative. Cyanosis and blood changes also occur. This compound is more toxic than its para isomer (ref. 9).

LD_{50} (oral, rat): 288 mg/kg.

Aquatic toxicity: TLm 96: 1,000-100 ppm.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 288 = 1.3 \times 10^4$ µg/m³

Water, Health: $15 \times 1.3 \times 10^4 = 2.0 \times 10^5$ µg/ℓ

Land, Health: $0.002 \times 2.0 \times 10^5 = 400$ µg/g

Air, Ecology:

Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ µg/ℓ

Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 288 = 31$ µg/m³

$EPC_{AH3} = 0.081 \times 288 = 23$ µg/m³

$EPC_{WH1} = 15 \times 23 = 345$ µg/ℓ

$EPC_{WH2} = 0.4 \times 288 = 115$ µg/ℓ

$EPC_{LH} = 0.002 \times 115 = 0.2$ µg/g

$EPC_{WE1} = 50 \times 100 = 5,000$ µg/ℓ

$EPC_{LE} = 0.002 \times 5,000 = 10$ µg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.3E4		23		
Water, $\mu g/l$ (ppm Wt)			2.0E5	1.0E4	115	5,000	
Land, $\mu g/g$ (ppm Wt)			4.0E2	2.0E1	0.2	10	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			23		
Water, $\mu g/l$ (ppm Wt)			115	5,000	
Land, $\mu g/g$ (ppm Wt)			0.2	10	

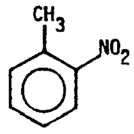
CATEGORY: 17

WLN: WNR B; WNR C; WNR D

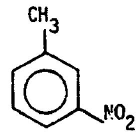
NITROTOLUENES: $C_7H_7NO_2$ (methylnitrobenzenes).

2-nitrotoluene: yellow liquid.
3-nitrotoluene: liquid.
4-nitrotoluene: yellowish crystals.

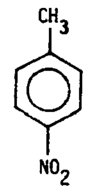
STRUCTURE:



2-Nitrotoluene
(o-nitrotoluene)



3-Nitrotoluene
(m-nitrotoluene)



4-Nitrotoluene
(p-nitrotoluene)

PROPERTIES:	Mol. wt.	mp	bp	d_4^{20}	Water Solubility	vap. d	vap. press.
2-nitrotoluene	137.13	-10	222	1.163	insoluble	4.72	1 mm at 50°
3-nitrotoluene	137.13	15.5	231.9	1.157	0.5 g/ℓ water	4.72	1 mm at 50.2°
4-nitrotoluene	137.13	53-54	238	1.286	insoluble	4.72	1 mm at 53.7°

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

All nitro compounds are potentially explosive.

TOXIC PROPERTIES, HEALTH EFFECTS:

The nitrotoluenes are low-grade methemoglobin formers; cases of poisoning are uncommon. They are significantly less toxic than nitrobenzene; however, the different isomers exhibit different levels of toxicity (ref. 4). They can be absorbed through the intact skin and the respiratory tract (ref. 45).

	LD_{50} (oral, rat)	Aquatic toxicity
2-nitrotoluene	891 mg/kg	TLm 96: 100-10 ppm
3-nitrotoluene	1,072 mg/kg	——
4-nitrotoluene	2,144 mg/kg	——

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 30 mg/m^3 (5 ppm).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.0×10^4 μg/m^3 (5 ppm)
Water, Health: $15 \times 3.0 \times 10^4 = 4.5 \times 10^5$ μg/ℓ
Land, Health: $0.002 \times 4.5 \times 10^5 = 900$ μg/g

Air, Ecology:
Water, Ecology: $100 \times 10 = 1.0 \times 10^3$ μg/ℓ
Land, Ecology: $0.002 \times 1.0 \times 10^3 = 2$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 30/420 = 71$ μg/m^3
$EPC_{AH1a} = 5/420 = 0.01$ ppm
$EPC_{WH1} = 15 \times 71 = 1,065$ μg/ℓ
$EPC_{WH2} = 13.8 \times 30 = 414$ μg/ℓ
$EPC_{LH} = 0.002 \times 414 = 0.8$ μg/g

$EPC_{WE1} = 50 \times 10 = 500$ μg/ℓ
$EPC_{LE} = 0.002 \times 500 = 1$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.0E4 (5)		71 (0.01)		
Water, $\mu g/l$ (ppm Wt)			4.5E5	1.0E3	414	500	
Land, $\mu g/g$ (ppm Wt)			9.0E2	2.0E0	0.8	1	

*To be multiplied by dilution factor

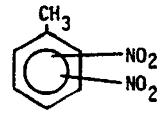
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			71 (0.01)		
Water, $\mu g/l$ (ppm Wt)			414	500	
Land, $\mu g/g$ (ppm Wt)			0.8	1	

CATEGORY: 17

WLN:

DINITROTOLUENES: $C_7H_6N_2O_4$.

STRUCTURE:



Dinitrotoluenes crystallize mainly in the form of yellow needles from ethanol or carbon disulfide.

PROPERTIES:	Mol. wt.	mp	bp	d	solubility	vap. d.
2,6-Dinitrotoluene	182.14	66	--	1.283		
3,4-Dinitrotoluene	182.14	58.3	--	1.259	insoluble	
All isomers	182.14	52-93	sublimes to 300°C	1.259-1.321	insoluble to slightly soluble	6.27 (for 2,4 isomer)

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

All nitro compounds are potentially explosive.

TOXIC PROPERTIES, HEALTH EFFECTS:

Toxic effects of dinitrotoluenes are similar to those of other aromatic nitro compounds. It causes central nervous system and blood disorders (ref. 4).

Dinitrotoluenes may be absorbed through the skin.

	LD_{50} (oral, rat)	Aquatic toxicity
2,3-dinitrotoluene	1,122 mg/kg	TLm 96: 100-10 ppm
2,4-dinitrotoluene	268 mg/kg	TLm 96: 100-10 ppm
2,5-dinitrotoluene	707 mg/kg	TLm 96: 100-10 ppm
2,6-dinitrotoluene	177 mg/kg	TLm 96: 100-10 ppm
3,4-dinitrotoluene	177 mg/kg	TLm 96: 100-10 ppm
3,5-dinitrotoluene		

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Dinitrotoluenes are on EPA Consent Decree Priority III List.

TLV = 1.5 mg/m^3 (By analogy with limits recommended for nitro and dinitro-benzenes).

On First Priority Chemicals List of the Chemical Industry Institute of Toxicology (ref. 8).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.5×10^3 µg/m^3

Water, Health: $15 \times 1.3 \times 10^3 = 2.25 \times 10^4$ µg/ℓ

Land, Health: $0.002 \times 2.25 \times 10^4 = 45$ µg/g

Air, Ecology:

Water, Ecology: $100 \times 10 = 1.0 \times 10^3$ µg/ℓ

Land, Ecology: $0.002 \times 1.0 \times 10^3 = 2$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 1.5/420 = 3.6$ µg/m^3

$EPC_{WH1} = 15 \times 3.6 = 54$ µg/ℓ

$EPC_{WH2} = 13.8 \times 1.5 = 21$ µg/ℓ

$EPC_{LH} = 0.002 \times 21 = 0.04$ µg/g

$EPC_{WE1} = 50 \times 10 = 500$ µg/ℓ

$EPC_{LE} = 0.002 \times 500 = 1$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.5E3		3.6		
Water, $\mu g/l$ (ppm Wt)			2.25E4	1.0E3	21	500	
Land, $\mu g/g$ (ppm Wt)			4.5E1	2.0E0	0.04	1	

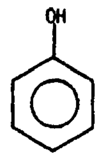
*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			3.6		
Water, $\mu g/l$ (ppm Wt)			21	500	
Land, $\mu g/g$ (ppm Wt)			0.04	1	

CATEGORY: 18A

WLN: QR

STRUCTURE:



PHENOL: C_6H_5OH (carbolic acid, hydroxybenzene, oxybenzene, phenic acid, phenylic acid, phenyl hydroxide).
Colorless needles, characteristic odor; reddens on exposure to air and light.

PROPERTIES:

Molecular wt: 94.11; mp: 43; bp: 181.75; d: 1.072 at 20°/4°; vap. press.: 1 mm at 40.1°C; vap. d: 3.24; soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The odor threshold for phenol is reported as 0.047 ppm or 180 $\mu g/m^3$ (ref. 29). Because of its low volatility, however, phenol is primarily of concern as a water contaminant rather than an air contaminant.

Phenol is obtained from coal tar (refs. 24, 63).

If phenolic compounds are present in waters that are chlorinated for disinfection, chlorophenols may be formed (ref. 28).

TOXIC PROPERTIES, HEALTH EFFECTS:

Phenol is absorbed through the gastrointestinal and respiratory tracts and through the skin. Acute and chronic poisoning may result from exposure. Chronic poisoning results in damage to the liver and kidney (ref. 9). Human ingestion of 14 mg/kg has resulted in gastrointestinal effects, and ingestion of 140 mg/kg is reported to cause death to a human (ref. 2).

LD_{50} (oral, rat): 414 mg/kg.

Phenol is included in the NIOSH list of suspected carcinogens. The NIOSH ordering number is 3121. The lowest TD_{Lo} is 4,000 mg/kg; the adjusted ordering number is 0.78. There is no specific evidence of human cancer attributable to phenol (ref. 63).

Experiments with Drosophilia have shown phenol to be highly mutagenic (ref. 64).

Aquatic toxicity: TLm 96: 100-10 ppm. As low as 79 $\mu g/\ell$ are toxic to minnows in freshwater after 30 minutes (ref. 28). Concentrations of 1 to 10 mg/ℓ in water result in tainting of fish flesh (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 19 mg/m^3 (5 ppm). On EPA Consent Decree Priority III list. On First Priority Chemicals List of the Chemical Industry Institute of Toxicology (ref. 8).

Phenol is the subject of a NIOSH criteria document. NIOSH recommends exposure to phenol vapor, solid, or mists be limited to 20 mg/m^3 as a time-weighted average for up to a 10-hour workday (ref. 65).

EPA 1976 Water Quality Criteria (proposed): 1 $\mu g/\ell$ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 $\mu g/\ell$ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 $\mu g/\ell$ at any time or place; application factor of 0.05 (for phenols) (ref. 28).

U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 $\mu g/\ell$ (for phenols) (ref. 66).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.9×10^4 $\mu g/m^3$ (5 ppm)
Water, Health: $5 \times 1 = 5$ $\mu g/\ell$
Land, Health: $0.002 \times 5 = 0.01$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 5 = 500$ $\mu g/\ell$
Land, Ecology: $0.002 \times 500 = 1$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 19/420 = 45$ $\mu g/\ell$
$EPC_{AH1a} = 5/420 = 0.01$ ppm
$EPC_{WH1} = 15 \times 45 = 675$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 19 = 260$ $\mu g/\ell$
$EPC_{WHS} = 1$ $\mu g/\ell$ (phenolic compounds)
$EPC_{LH} = 0.002 \times 1 = 0.002$ $\mu g/g$

$EPC_{WE1} = 50 \times 10 = 500$ $\mu g/\ell$
$EPC_{WE2} = 1,000$ $\mu g/\ell$ (to prevent tainting)
$EPC_{WES} = 100$ $\mu g/\ell$ (phenolic compounds)
$EPC_{LE} = 0.002 \times 100 = 0.2$ $\mu g/g$

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.9E4 (5)		45 (0.01)		
Water, $\mu g/l$ (ppm Wt)			5.0E0	5.0E2	1	100	
Land, $\mu g/g$ (ppm Wt)			1.0E-2	1.0E0	0.002	0.2	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			45 (0.01)		
Water, $\mu g/l$ (ppm Wt)	1†	100†	260	500	
Land, $\mu g/g$ (ppm Wt)			0.002	0.2	

†Phenolic compounds.

CATEGORY: 18A

WLN:

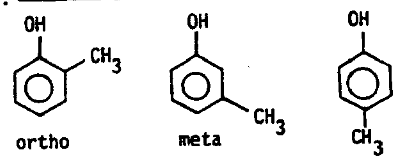
CRESOLS: $C_6H_4OHCH_3$ (cresylic acid, methylphenol, hydroxytoluene).

m-cresol: colorless or yellowish liquid, phenolic odor;

o-cresol: crystals or liquid, phenolic odor;

p-cresol: crystals, phenolic odor.

STRUCTURE:



ortho meta para

PROPERTIES:

Molecular wt: 108.37; density$^4_{20}$: 1.034-1.047;

vap. d: 3.72; soluble in water.

	mp	bp	vap. press.
m-cresol	11	202	0.153 mm at 25°C
o-cresol	30	191	0.245 mm at 25°C
p-cresol	35.5	201.8	0.108 mm at 25°C

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Cresols are methyl-substituted hydroxy benzene compounds, i.e. methyl phenols. Ortho, meta and para compounds occur. The meta isomer predominates in mixtures (ref. 24)

Odor recognition level for cresols ranges from 0.9 to 1.21 mg/m^3 or 0.20 to 0.27 ppm (ref. 3).

The odor threshold in air for p-cresol is reported as 0.001 ppm or 4 μg/m^3 (ref. 29).

Cresols are obtained from coal tar (ref. 24). Due to the low vapor pressure and disagreeable odor, cresols usually do not present an acute inhalation hazard (ref. 63).

Cresols are highly resistant to biological oxidation (ref. 67).

TOXIC PROPERTIES, HEALTH EFFECTS:

Toxic properties of cresols are similar to those of phenol. Cresols may be absorbed through the skin. Respiratory hazard is low because of low volatility. Absorption may cause damage to liver, kidney and nervous system (ref. 9). Order of toxicity beginning with most toxic is reported to be as follows: p-cresol; o-cresol; phenol; m-cresol (ref. 4)

	LD_{50} (oral, rat)
m-cresol	242 mg/kg
o-cresol	121 mg/kg
p-cresol	207 mg/kg

Toxicity to aquatic life: tainting of fish may result from concentrations of 0.07 mg/ℓ of mixed cresol isomers (ref. 28). The toxic concentration of p-cresol is 5 ppm for rainbow trout (ref. 36). The 96-hour LC_{50} for p-cresol is reported as 19 mg/ℓ (ref. 68). For mixed cresol isomers, the 96-hour TLm is reported as 10-1 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV for Cresol (all isomers): 22 mg/m^3 (5 ppm).

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (for phenols) (ref. 28).

U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 μg/ℓ (for phenols) (ref. 66).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2.2 x 10^4 μg/m^3 (5 ppm)

Water, Health: 5 x 1 = 5 μg/ℓ

Land, Health: 0.002 x 5 = 0.01 μg/g

Air, Ecology:

Water, Ecology: 100 x 5 = 500 μg/ℓ

Land, Ecology: 0.002 x 500 = 1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH1} = 10^3 x 22/420 = 52 μg/m^3

EPC_{AH1a} = 5/420 = 0.01ppm

EPC_{WH1} = 15 x 52 = 780 μg/ℓ

EPC_{WH2} = 13.8 x 22 = 304 μg/ℓ

EPC_{WHS} = 1 μg/ℓ (phenolic compounds)

EPC_{LH} = 0.002 x 1 = 0.002 μg/g

EPC_{WE1} = 50 x 1 = 50 μg/ℓ

EPC_{WE2} = 70 μg/ℓ

EPC_{WES} = 100 μg/ℓ (phenolic compounds)

EPC_{LE} = 0.002 x 50 = 0.1 μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			2.2E4		52 (0.01)		
Water, μg/l (ppm Wt)			5.0E0	5.0E2	1	70	
Land, μg/g (ppm Wt)			1.0E-2	1.0E0	0.002	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			52 (0.01)		
Water, μg/l (ppm Wt)	1†	100†	304	50	
Land, μg/g (ppm Wt)			0.002	0.1	

†Phenolic compounds.

CATEGORY: 18A

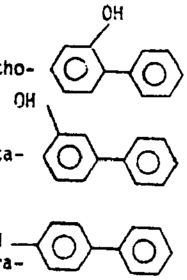
WLN: QR BR; QR CR; QR DR

STRUCTURE:

ortho-

meta-

para-



PHENYLPHENOLS: $C_6H_5C_6H_4OH$ (hydroxybiphenyls, biphenylols ortho, meta, or para phenylphenols).

o-phenylphenol: white, flaky crystals; mild, characteristic ordor.

p-phenylphenol: needles.

m-phenylphenol: needles.

PROPERTIES:

Molecular wt: 170.21; insoluble in water.

	mp	bp	d	vap. press.
o-phenylphenol	58-60	286	1.213	1 mm at 100°C
p-phenylphenol	165-167	305-8 sublimes		10 mm at 176°C
m-phenylphenol	78	>300		

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Phenylphenols are monosubstituted phenolic compounds. Ortho, meta, and para phenylphenols are formed.

TOXIC PROPERTIES, HEALTH EFFECTS:

The toxic properties of phenylphenols are probably similar to those of the other phenols. Animal studies indicate that acute and chronic toxicity is mild for o-phenylphenol (ref. 63).

LD_{50} (oral, rat): 2,700 mg/kg (for o-phenylphenol).

Neoplastic effects have resulted from the subcutaneous administration to mice of 1,000 mg/kg of the para isomer. The EPA/NIOSH ordering number is 3101; the adjusted ordering number is 3.1.

Tainting of fish flesh may result from concentrations of 1 mg/ℓ of o-phenylphenol (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (ref. 28).

U.S. Public Health Service Drinking Water Standards, 1972--Levels for alternate source selection: 1 μg/ℓ (ref. 66).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/3.1 = 2.25 \times 10^4$ μg/m^3

Water, Health: $5 \times 1 = 5$ μg/ℓ

Land, Health: $0.002 \times 5 = 0.01$ μg/g

Air, Ecology:

Water, Ecology: $100 \times 5 = 500$ μg/ℓ

Land, Ecology: $0.002 \times 500 = 1$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 2,700 = 290$ μg/m^3

$EPC_{AH3} = 0.081 \times 2,700 = 220$ μg/m^3

$EPC_{WH1} = 15 \times 220 = 3,300$ μg/ℓ

$EPC_{WH2} = 0.4 \times 2,700 = 1,080$ μg/ℓ

$EPC_{WHS} = 1$ μg/ℓ (phenolic compounds)

$EPC_{LH} = 0.002 \times 1 = 0.002$ μg/g

$EPC_{AC1} = 10^3/(6 \times 3.1) = 54$ μg/m^3

$EPC_{WC} = 15 \times 53 = 810$ μg/ℓ

$EPC_{LC} = 0.002 \times 810 = 1.6$ μg/g

$EPC_{WE2} = 1,000$ μg/ℓ (to prevent tainting)

$EPC_{WES} = 100$ μg/ℓ (phenolic compounds)

$EPC_{LE} = 0.002 \times 100 = 0.2$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.25E4		54		
Water, $\mu g/l$ (ppm Wt)			5.0E0	5.0E2	1	100	
Land, $\mu g/g$ (ppm Wt)			1.0E-2	1.0E0	0.002	0.2	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

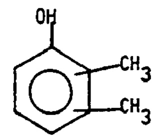
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			220		54
Water, $\mu g/l$ (ppm Wt)	1†	100†	1,080	1,000	810
Land, $\mu g/g$ (ppm Wt)			0.002	0.2	1.6

†Phenolic compounds.

CATEGORY: 18A

WLN:

STRUCTURE:



XYLENOLS: $C_6H_3OH(CH_3)_2$ (dimethylphenols, dimethylhydroxybenzenes).
Colorless or white crystals or needles.

PROPERTIES:

Molecular wt: 122.17; mp: 27-75; bp: 210-225 (one isomer sublimes); d: 0.9650^{20}_{4}-0.9830^{20}_{4}; vap. press.: 1 mm at 52° to 1 mm at 66°; soluble to slightly soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Xylenols are disubstituted phenols.
Several isomers are formed since numerous substitution site combinations are possible.
The properties of the various isomers differ somewhat. Xylenols will probably occur in combination.

TOXIC PROPERTIES, HEALTH EFFECTS:

Toxic properties of the xylenols are similar to those of phenol and other phenolic compounds. The lowest LD_{50} (oral, rat) reported for a specific xylenol is 296 mg/kg for 2,6-xylenol. It is probable that mixtures of the various isomers would prove less toxic than 2,6-xylenol.

Oncogenic effects have been reported as a result of animal exposure via skin to five specific xylenol isomers. Considering the compounds collectively the EPA/NIOSH ordering number is 3111, and the lowest dosage resulting in an oncogenic response is 4,000 mg/kg. The adjusted ordering number is 0.8.

Aquatic toxicity: 96-hr LC_{50} for fat head minnow: 14 mg/ℓ (ref. 68).

Tainting of fish flesh may result from concentrations of 1 to 5 mg/ℓ in water (ref. 69).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (ref. 28).

U.S. Public Health Service Drinking Water Standards, 1972--Levels for alternate source selection: 1 μg/ℓ (ref. 66).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 296 = 1.3 \times 10^4$ μg/m³

Water, Health: $5 \times 1 = 5$ μg/ℓ

Land, Health: $0.002 \times 5 = 0.01$ μg/g

Air, Ecology:

Water, Ecology: $100 \times 5 = 500$ μg/ℓ

Land, Ecology: $0.002 \times 500 = 1$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 296 = 32$ μg/m³

$EPC_{AH3} = 0.081 \times 296 = 24$ μg/m³

$EPC_{WH1} = 15 \times 24 = 360$ μg/ℓ

$EPC_{WH2} = 0.4 \times 296 = 120$ μg/ℓ

$EPC_{WHS} = 1$ μg/ℓ (phenolic compounds)

$EPC_{LH} = 0.002 \times 1 = 0.002$ μg/g

$EPC_{WE1} = 50 \times 14{,}000 = 7 \times 10^5$ μg/ℓ

$EPC_{WE2} = 1{,}000$ μg/ℓ

$EPC_{WES} = 100$ μg/ℓ (phenolic compounds)

$EPC_{LE} = 0.002 \times 100 = 0.2$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, µg/m³ (ppm Vol)			1.3E4		24		
Water, µg/l (ppm Wt)			5.0E0	5.0E2	1	100	
Land, µg/g (ppm Wt)			1.0E-2	1.0E0	0.002	0.2	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, µg/m³ (ppm Vol)			24		
Water, µg/l (ppm Wt)	1†	100†			
Land, µg/g (ppm Wt)			0.002	0.2	

†Phenolic compounds.

CATEGORY: 18A

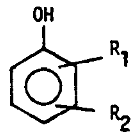
ALKYL CRESOLS: $C_6H_3OHCH_3C_nH_{2n+1}$ (methyl ethylphenols).

PROPERTIES:

Molecular wt. >122; very slightly soluble; higher boiling points than the corresponding xylenols.

WLN:

STRUCTURE: There are 12 possible structural isomers for each substituted alkyl group. For example, there are 12 isomers of methylethylphenol.



Where R_1 and R_2 are any alkyl groups.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Alkyl cresols are disubstituted phenols with one of the substitution groups being methyl. An example of an alkyl cresol is methyl ethylphenol. A number of isomers are possible depending on the substitution sites.

TOXIC PROPERTIES, HEALTH EFFECTS:

Toxic properties are expected to be similar to xylenols.

LD_{50} (rat): 530 mg/kg for 6 ethyl-m-cresol. The route of administration was not reported. This value is the lowest LD_{50} reported for the alkyl cresols.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (for phenols) (ref. 28).

U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 μg/ℓ (for phenols) (ref. 66).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 530 = 2.4 \times 10^4$ μg/m^3

Water, Health: $5 \times 1 = 5$ μg/ℓ

Land, Health: $0.002 \times 5 = 0.01$ μg/g

Air, Ecology:

Water, Ecology: $5 \times 100 = 500$ μg/ℓ

Land, Ecology: $0.002 \times 500 = 1$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 530 = 57$ μg/m^3

$EPC_{AH3} = 0.081 \times 530 = 43$ μg/m^3

$EPC_{WH1} = 15 \times 43 = 640$ μg/ℓ

$EPC_{WH2} = 0.4 \times 530 = 212$ μg/ℓ

$EPC_{WHS} = 1$ μg/ℓ (phenolic compounds)

$EPC_{LH} = 0.002 \times 1 = 0.002$ μg/g

$EPC_{WES} = 100$ μg/ℓ (phenolic compounds)

$EPC_{LE} = 0.002 \times 100 = 0.2$ μg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.4E4		43		
Water, $\mu g/l$ (ppm Wt)			5.0E0	5.0E2	1	100	
Land, $\mu g/g$ (ppm Wt)			1.0E-2	1.0E0	0.002	0.2	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			43		
Water, $\mu g/l$ (ppm Wt)	1†	100†	212		
Land, $\mu g/g$ (ppm Wt)			0.002	0.2	

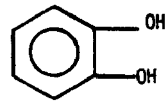
†Phenolic compounds.

CATEGORY: 18B

WLN: QR BQ

CATECHOL: $C_6H_4(OH)_2$ (pyrocatechol, o-dihydroxybenzene, o-benzendiol, 1,2-dihydroxybenzene, o-hydroxyphenol, 2-hydroxyphenol). White or colorless leaflets.

STRUCTURE:



PROPERTIES:

Molecular wt: 110.08; mp: 105; bp: 245^{750}; d: 1.344^{21}; soluble; vap. press.: 10 mm at 118.3°; vap. d: 3.79; sublimes readily; soluble in 2.3 parts water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Catechol is a dihydric phenol.

When heated, catechol emits highly toxic fumes; it is volatilized by steam. A related compound is methyl pyrocatechol.

TOXIC PROPERTIES, HEALTH EFFECTS:

Catechol is similar to phenol in its toxic properties causing convulsions and injury to the blood. It is absorbed through the skin as well as through inhalation (refs. 9, 63).

The repeated absorption of sublethal doses by animals may induce methemoglobinemia, leukopenia, and anemia (ref. 63).

LD_{50} (rats, oral): 3,890 mg/kg.

Tainting of fish flesh may result from concentrations of 0.8 to 5 mg/ℓ of catechol (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 20 mg/m^3 (5 ppm) (Trial).

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (for phenols) (ref. 28).

U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 μg/ℓ (for phenols) (ref. 66).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2.0×10^4 μg/m^3 (5ppm)	Air, Ecology:
Water, Health: 5 x 1 = 5 μg/ℓ	Water, Ecology: 5 x 100 = 500 μg/ℓ
Land, Health: 0.002 x 5 = 0.01 μg/g	Land, Ecology: 0.002 x 500 = 1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 20/420 = 48$ μg/m^3	
$EPC_{AH1a} = 5/420 = 0.01$ppm	
$EPC_{WH1} = 15 \times 48 = 720$ μg/ℓ	
$EPC_{WH2} = 13.8 \times 20 = 280$ μg/ℓ	$EPC_{WE2} = 800$ μg/ℓ (to prevent tainting)
$EPC_{WHS} = 1$ μg/ℓ (phenolic compounds)	$EPC_{WES} = 100$ μg/ℓ (phenolic compounds)
$EPC_{LH} = 0.002 \times 1 = 0.002$ μg/g	$EPC_{LH} = 0.002 \times 100 = 0.2$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, µg/m^3 (ppm Vol)			2.0E4 (5)		48 (0.01)		
Water, µg/l (ppm Wt)			5.0E0	5.0E2	1	100	
Land, µg/g (ppm Wt)			1.0E-2	1.0E0	0.002	0.2	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, µg/m^3 (ppm Vol)			48 (0.01)		
Water, µg/l (ppm Wt)	1†	100†	280	800	
Land, µg/g (ppm Wt)			0.002	0.2	

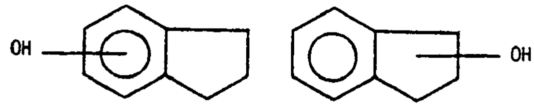
†Phenolic compounds.

CATEGORY: 18C

WLN: L56T&J GQ

INDANOLS: $C_9H_{10}O$ (hydroxyhydrindene, hydroxyindene).
Plates, triclinic prisms, or needles.

STRUCTURE:



I II

PROPERTIES:

Molecular wt: 134.18; mp: 40-56; bp: 255.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Indanol may or may not be phenolic, depending on the site of hydroxy substitution. Structure I is a phenol, II is not. Little information regarding indanols is available. The physical properties described are for 1-indanol, 4-indanol, and 5-indanol.

TOXIC PROPERTIES, HEALTH EFFECTS:

Toxic properties are probably similar to but milder than phenol. Limited animal experiments suggest moderate toxicity and a high degree of irritation (ref. 9).

LD_{50} (oral, rat): 3,250 mg/kg for a 5-indanol.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (for phenols) (ref. 28).

U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 μg/ℓ (for phenols) (ref. 66).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 3{,}250 = 1.5 \times 10^5$ μg/m^3

Water, Health: $5 \times 1 = 5$ μg/ℓ

Land, Health: $0.002 \times 5 = 0.01$ μg/g

Air, Ecology:

Water, Ecology: $5 \times 100 = 500$ μg/ℓ

Land, Ecology: $0.002 \times 500 = 1$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 3{,}250 = 350$ μg/m^3

$EPC_{AH3} = 0.081 \times 3{,}250 = 260$ μg/m^3

$EPC_{WH1} = 15 \times 260 = 3{,}900$ μg/ℓ

$EPC_{WH2} = 0.4 \times 3{,}250 = 1{,}300$ μg/ℓ

$EPC_{WHS} = 1$ μg/ℓ (phenolic compounds)

$EPC_{LH} = 0.002 \times 1 = 0.002$ μg/g

$EPC_{WES} = 100$ μg/ℓ (phenolic compounds)

$EPC_{LE} = 0.002 \times 100 = 0.2$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.5E5		260		
Water, $\mu g/l$ (ppm Wt)			5.0E0	5.0E2	1	100	
Land, $\mu g/g$ (ppm Wt)			1.0E-2	1.0E0	0.002	0.2	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			260		
Water, $\mu g/l$ (ppm Wt)	1†	100†	1,300		
Land, $\mu g/g$ (ppm Wt)			0.002	0.2	

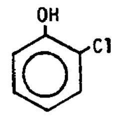
†Phenolic compounds.

CATEGORY: 19

WLN: QR BG

2-CHLOROPHENOL: C_6H_5OCl (o-chlorophenol).
Light amber liquid; distinct odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 128.6; mp: 9.0; bp: 174.9; d: 1.263; vap. press.: 1 mm at 12.1°C; solubility in water: 2.85 g in 100 ml at 20°.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The chlorophenols are primarily water and soil contaminants.

Chlorination of phenols in aqueous solution can occur under conditions similar to those used in chlorine disinfection (ref. 70).

Chlorophenols are stronger acids than phenols because of the chlorine atoms. They, like phenols, will form ethers, esters, and salts with metals, amines, etc.

Aqueous photolysis may lead to hydroxyl substitution for the chlorines and polymer formation.

In terms of biological degradation, chlorophenols are much more environmentally stable than the parent phenol. Microbial decomposition of 2-chlorophenol required 3 to 9 days for complete disappearance as compared to 1 to 2 days for phenol (ref. 70).

TOXIC PROPERTIES, HEALTH EFFECTS:

Chlorophenols may be absorbed through the skin as well as by inhalation of the vapors. They are considered corrosive to skin and eyes, and the vapors are irritating and toxic.

LD_{50} (oral, rat): 670 mg/kg.

2-chlorophenol is included in the NIOSH Suspected Carcinogens List. The NIOSH ordering number is 3121, and the lowest toxic dose resulting in an oncogenic response is 38 g/kg. The adjusted ordering number is 0.09.

Concentrations of 0.0001 to 0.015 mg/ℓ in water may cause tainting of fish flesh (refs. 36, 33).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (ref. 28).

U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 μg/ℓ (for phenols) (ref. 66).

Candidate for the list for Toxic Pollutant Effluent Limitations (ref. 10). On EPA Consent Decree Priority II List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 45 x 670 = 3.0×10^4 μg/m^3

Water, Health: 5 x 1 = 5 μg/ℓ

Land, Health: 0.002 x 5 = 0.01 μg/g

Air, Ecology:

Water, Ecology: 5 x 100 = 500 μg/ℓ

Land, Ecology: 0.002 x 500 = 1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH2} = 0.107 x 670 = 72 μg/m^3

EPC_{AH3} = 0.081 x 670 = 54 μg/m^3

EPC_{WH1} = 15 x 54 = 810 μg/ℓ

EPC_{WH2} = 0.4 x 670 = 270 μg/ℓ

EPC_{WHS} = 1 μg/ℓ (phenolic compounds)

EPC_{LH} = 0.002 x 1 = 0.002 μg/g

EPC_{WE2} = 0.1 μg/ℓ (to prevent tainting)

EPC_{WES} = 100 μg/ℓ (phenolic compounds)

EPC_{LE} = 0.002 x 0.1 = 0.00001 μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.0E4		54		
Water, $\mu g/l$ (ppm Wt)			5.0E0	5.0E2	1	0.1	
Land, $\mu g/g$ (ppm Wt)			1.0E-2	1.0E0	0.002	0.00001	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			54		
Water, $\mu g/l$ (ppm Wt)	1†	100†	270	0.1	
Land, $\mu g/g$ (ppm Wt)			0.002	0.00001	

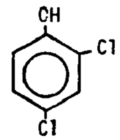
†Phenolic compounds.

CATEGORY: 19

WLN: QR BG DG

2,4-DICHLOROPHENOL: $C_6H_4OCl_2$.
Colorless crystals.

STRUCTURE:



PROPERTIES:

Molecular wt: 163.0; mp: 45; bp: 210-211;
d: 1.383^{60}_{25}; vap. d.: 5.62; vap. press: 1 mm at 53° C; solubility in water: 0.45 g in 100 ml at 20°.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The chlorophenols are primarily water and soil contaminants. Chlorination of phenols in an aqueous solution can occur under conditions similar to those used in chlorine disinfection (refs. 36,28). Chlorophenols are stronger acids than phenols because of the chlorine atoms. They, like phenols, will form ethers, esters, and salts with metals, amines, etc. It has been identified in samples of U.S. drinking water supplies at 36 μg/ℓ (ref. 13).

In terms of biological degradation the chlorophenols are much more environmentally stable than the parent phenol. The rate of decomposition further decreases as the number of chlorine atoms increases. Microbial decomposition of 2,4-dichlorophenol required 5 to 9 days for complete disappearance as compared to 1 to 2 days required for phenol (ref. 70).

TOXIC PROPERTIES, HEALTH EFFECTS:

Chlorophenols may be absorbed through skin as well as by inhalation of the vapors. They are considered corrosive to skin and eyes, and vapors are irritating and toxic. Dichlorophenols are more toxic than monochlorophenols.

LD_{50}(oral, rat): 580 mg/kg.

2,4-dichlorophenol is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3121. The lowest TD_{Lo} affecting an oncogenic response is 312 mg/kg. The adjusted ordering number is 10.

Concentrations of 0.0004 to 0.014 mg/ℓ in water may cause tainting of fish flesh (refs. 36,33).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (ref. 28).

U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 μg/ℓ (for phenols) (ref. 66).

On EPA Consent Decree Priority II List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/10 = 7 \times 10^3$ μg/m³
Water, Health: 5 x 1 = 5 μg/ℓ
Land, Health: 0.002 x 5 = 0.01 μg/g

Air, Ecology:
Water, Ecology: 5 x 100 = 500 μg/ℓ
Land, Ecology: 0.002 x 500 = 1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 580 = 62$ μg/m³
$EPC_{AH3} = 0.081 \times 580 = 47$ μg/m³
$EPC_{WH1} = 15 \times 47 = 705$ μg/ℓ
$EPC_{WH2} = 0.4 \times 580 = 232$ μg/ℓ
$EPC_{WHS} = 1$ μg/ℓ (phenolic compounds)
$EPC_{LH} = 0.002 \times 1 = 0.002$ μg/g
$EPC_{AC2} = 10^3/(6 \times 10) = 17$ μg/m³
$EPC_{WC} = 15 \times 17 = 255$ μg/ℓ
$EPC_{LC} = 0.002 \times 255 = 0.5$ μg/g

$EPC_{WE2} = 0.4$ μg/ℓ (to prevent tainting)
$EPC_{WES} = 100$ μg/ℓ (phenolic compounds)
$EPC_{LE} = 0.002 \times 0.4 = 0.0008$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			7.0E3		17		
Water, $\mu g/l$ (ppm Wt)			5.0E0	5.0E2	1	0.4	
Land, $\mu g/g$ (ppm Wt)			1.0E-2	1.0E0	0.002	0.0008	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			47		17
Water, $\mu g/l$ (ppm Wt)	1†	100†	232	0.4	255
Land, $\mu g/g$ (ppm Wt)			0.002	0.0008	0.5

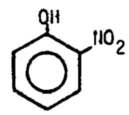
†Phenolic compounds.

CATEGORY: 20

WLN: WNR BQ

2-NITROPHENOL: $C_6H_5NO_3$ (o-nitrophenol).
2-nitrophenol crystallizes as yellow needles from ethanol; peculiar aromatic odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 139.12; mp: 44.9; bp: 216; d: 1.495; vap. press: 1 mm at 49°; sparingly soluble in cold water; volatile in steam.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

All nitro compounds are potentially explosive.
Nitrophenols are formed by the reaction of nitric acid with phenols.

TOXIC PROPERTIES, HEALTH EFFECTS:

2-nitrophenol is a stronger acid than phenol. Contact of 2-nitrophenol with the skin may cause irritation or burns. It is absorbed through intact skin and through the respiratory tract (ref. 45). Liver and kidney damage has been observed in experimental animals (ref. 9).

LD_{50} (oral, rat): 1,297 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).
NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (for phenols) (ref. 28).
U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 μg/ℓ (for phenols) (ref. 66).
2-Nitrophenol is on EPA Consent Decree Priority III List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 45 x 1,297 = 5.8×10^4 μg/m³
Water, Health: 5 x 1 = 5 μg/ℓ
Land, Health: 0.002 x 5 = 0.01 μg/g

Air, Ecology:
Water, Ecology: 5 x 100 = 500 μg/ℓ
Land, Ecology: 0.002 x 500 = 1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH2} = 0.107 x 1,297 = 139 μg/m³
EPC_{AH3} = 0.081 x 1,297 = 105 μg/m³
EPC_{WH1} = 15 x 105 = 1,580 μg/ℓ
EPC_{WH2} = 0.4 x 1,297 = 520 μg/ℓ
EPC_{WHS} = 1 μg/ℓ (phenolic compounds)
EPC_{LH} = 0.002 x 1 = 0.002 μg/g

EPC_{WES} = 100 μg/ℓ (phenolic compounds)
EPC_{LE} = 0.002 x 100 = 0.2 μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
Category	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			5.8E4		105		
Water, μg/l (ppm Wt)			5.0E0	5.0E2	1	100	
Land, μg/g (ppm Wt)			1.0E-2	1.0E0	0.002	0.2	

*To be multiplied by dilution factor

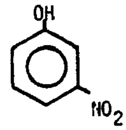
	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			105		
Water, μg/l (ppm Wt)	1†	100†	520		
Land, μg/g (ppm Wt)			0.002	0.2	

†Phenolic compounds.

CATEGORY: 20

WLN: WNR CQ

STRUCTURE:



3-NITROPHENOL: $C_6H_5NO_3$ (m-nitrophenol).
3-nitrophenol can be crystallized from an aqueous solution of hydrochloric acid.

PROPERTIES:

Molecular wt: 139.12; mp: 97; bp: 194 at 70 mm; d: 1.485_4^{20}; soluble in hot water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

All nitro compounds are potentially explosive.
Nitrophenols are formed by the reaction of nitric acid with phenols.

TOXIC PROPERTIES, HEALTH EFFECTS:

3-Nitrophenol is a stronger acid than phenol.
Contact of 3-nitrophenol with the skin may cause irritation or burns.
LD_{50} (oral, rat): 447 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).
NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (for phenols) (ref. 28).
U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 μg/ℓ (for phenols) (ref. 66).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 45 x 447 = 2.0×10^4 μg/m^3
Water, Health: 5 x 1 = 5 μg/ℓ
Land, Health: 0.002 x 5 = 0.01 μg/g

Air, Ecology:
Water, Ecology: 5 x 100 = 500 μg/ℓ
Land, Ecology: 0.002 x 500 = 1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH2} = 0.107 x 447 = 48 μg/m^3
EPC_{AH3} = 0.081 x 447 = 36 μg/m^3
EPC_{WH1} = 15 x 36 = 540 μg/ℓ
EPC_{WH2} = 0.4 x 447 = 180 μg/ℓ
EPC_{WHS} = 1 μg/ℓ (phenolic compounds)
EPC_{LH} = 0.002 x 1 = 0.002 μg/g

EPC_{WES} = 100 μg/ℓ (phenolic compounds)
EPC_{LE} = 0.002 x 100 = 0.2 μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, µg/m³ (ppm Vol)			2.0E4		36		
Water, µg/l (ppm Wt)			5.0E0	5.0E2	1	100	
Land, µg/g (ppm Wt)			1.0E-2	1.0E0	0.002	0.2	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, µg/m³ (ppm Vol)			36		
Water, µg/l (ppm Wt)	1†	100†	180		
Land, µg/g (ppm Wt)			0.002	0.2	

†Phenolic compounds.

CATEGORY: 20

WLN: WNR DQ

4-NITROPHENOL: $C_6H_5NO_3$ (p-nitrophenol).

p-Nitrophenol occurs in two forms: colorless prisms obtained by crystallization from toluene above 63, and yellow crystals obtained by crystallization from toluene below 63. Ordinary p-nitrophenol is a mixture of both forms; odorless.

STRUCTURE:

PROPERTIES:

Molecular wt: 139.12; mp: 114; bp: 279

d: 1.479^{20}; decomposes at 279; soluble in hot water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

All nitro compounds are potentially explosive.

Nitrophenols are formed by the reaction of nitric acid with phenols.

TOXIC PROPERTIES, HEALTH EFFECTS:

p-Nitrophenol is a stronger acid than phenol. Contact of p-nitrophenol with the skin may cause irritation or burns. The biological half-life of p-nitrophenol in man is reported as 0.041 days (ref. 20). Experiments have shown it to cause central nervous system depression and blood effects (ref. 9).

LD_{50} (oral, rat): 350 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (for phenols) (ref. 28).

U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 μg/ℓ (for phenols) (ref. 66)

p-Nitrophenol is on EPA Consent Decree Priority III List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 350 = 1.6 \times 10^4$ μg/m^3

Water, Health: $5 \times 1 = 5$ μg/ℓ

Land, Health: $0.002 \times 5 = 0.01$ μg/g

Air, Ecology:

Water, Ecology: $5 \times 100 = 500$ μg/ℓ

Land, Ecology: $0.002 \times 500 = 1$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 350 = 37$ μg/m^3

$EPC_{AH3} = 0.081 \times 350 = 28$ μg/m^3

$EPC_{WH1} = 15 \times 28 = 420$ μg/ℓ

$EPC_{WH2} = 0.4 \times 350 = 140$ μg/ℓ

$EPC_{WHS} = 1$ μg/ℓ (phenolic compounds)

$EPC_{LH} = 0.002 \times 1 = 0.002$ μg/g

$EPC_{WES} = 100$ μg/ℓ (phenolic compounds)

$EPC_{LE} = 0.002 \times 100 = 0.2$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.6E4		28		
Water, μg/l (ppm Wt)			5.0E0	5.0E2	1	100	
Land, μg/g (ppm Wt)			1.0E-2	1.0E0	0.002	0.2	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			28		
Water, μg/l (ppm Wt)	1†	100†	140		
Land, μg/g (ppm Wt)			0.002	0.2	

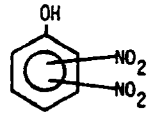
†Phenolic compounds.

CATEGORY: 20

WLN: WNR XQ XNW

DINITROPHENOLS: $C_6H_4N_2O_5$ (dinitrohydroxybenzenes). Dinitrophenols crystallize as colorless or yellowish crystals.

STRUCTURE:



PROPERTIES:

	Mol.wt.	mp	bp	d	solubility	vap.d.
2,4-dinitrophenol	184.11	115	sublimes	1.683	slightly sol.	6.35
2,5-dinitrophenol	184.11	108	-	-	slightly sol.	-
2,6-dinitrophenol	184.11	63	-	-	insol.	6.35
All isomers		63-144	-	1.672-1.702	-	-

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

All nitro compounds are potentially explosive.

Nitrophenols are formed by the reaction of nitric acid with phenols.

TOXIC PROPERTIES, HEALTH EFFECTS:

Dinitrophenols are stronger acids than phenol. Contact of dinitrophenols with the skin may cause irritation or burns; they are readily absorbed through intact skin and through the respiratory tract (ref. 24). Ingestion of 36 mg/kg of 2,4-dinitrophenol has resulted in human death (ref. 2).

Animal experiments indicate that dinitrophenols are more toxic than nitrophenols. They can cause increases in metabolism and temperature, dermatitis, and eye and nerve damage (ref. 24).

LD_{Lo} (oral, rat): 30 mg/kg for dinitrophenol (presumably this is for a mixture of the various isomers.)

The lowest LD_{50} (oral, rat) for a single dinitrophenol isomer is reported as 30 mg/kg for 2,4-dinitrophenol.

Aquatic toxicity: 96-hour TLm for 2,4-dinitrophenol is 10-1 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (for phenols) (ref. 28).

U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 μg/ℓ (for phenols) (ref. 66).

2,4-dinitrophenol is on EPA Consent Decree Priority III List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 45 x 30 = 1.35×10^3 $\mu g/m^3$

Water, Health: 5 x 1 = 5 μg/ℓ

Land, Health: 0.002 x 5 = 0.01 μg/g

Air, Ecology:

Water, Ecology: 5 x 100 = 500 μg/ℓ

Land, Ecology: 0.002 x 500 = 1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH2} = 0.107 x 30 = 3.2 $\mu g/m^3$

EPC_{AH3} = 0.081 x 30 = 2.4 $\mu g/m^3$

EPC_{WH1} = 15 x 2.4 = 36 μg/ℓ

EPC_{WH2} = 0.4 x 30 = 12 μg/ℓ

EPC_{WHS} = 1 μg/ℓ (phenolic compounds)

EPC_{LH} = 0.002 x 1 = 0.002 μg/g

EPC_{WE1} = 50 x 1 = 50 μg/ℓ

EPC_{WES} = 100 μg/ℓ (phenolic compounds)

EPC_{LE} = 0.002 x 50 = 0.1 μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, µg/m³ (ppm Vol)			1.35E3		2.4		
Water, µg/l (ppm Wt)			5.0E0	5.0E2	1	50	
Land, µg/g (ppm Wt)			1.0E-2	1.0E0	0.002	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

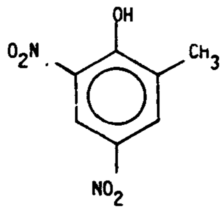
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, µg/m³ (ppm Vol)			2.4		
Water, µg/l (ppm Wt)	1†	100†	12	50	
Land, µg/g (ppm Wt)			0.002	0.1	

†Phenolic compounds.

CATEGORY: 20

WLN: WNR BQ C ENW

STRUCTURE:



4,6-DINITRO-o-CRESOL: $C_7H_6N_2O_5$ (2,4-dinitro-o-cresol, 2-methyl-4,6-dinitrophenol, DNOC).
Crystallizes as yellow prisms from ethanol.

PROPERTIES:

Molecular wt: 198; mp: 87.5; sparingly soluble in water; vap. d: 6.82; moderately volatile with steam.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

All nitro compounds are potentially explosive.

Nitrophenols are formed by the reaction of nitric acid with phenols.

TOXIC PROPERTIES, HEALTH EFFECTS:

4,6-Dinitro-o-cresol is a stronger acid than cresol.

Contact of 4,6-dinitro-o-cresol with the skin may cause irritation or burns.

4,6-Dinitro-o-cresol is absorbed through the skin.

The biological half-life of dinitro-o-cresol in man is reported as 5.78 days (ref. 20). Inhalation of 1 mg/m^3 has resulted in central nervous system effects in an exposed human (ref. 2).

LD_{50} (oral, rat): 25 mg/kg.

LC_{Lo} (inhalation, cat): 40 mg/m^3.

Aquatic toxicity: TLm 96: 10-1 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

4,6-Dinitro-o-cresol is on EPA Consent Decree Priority III List.

TLV = 0.2 mg/m^3 (0.025 ppm)

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (for phenols) (ref. 28).

U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 μg/ℓ (for phenols) (ref. 66).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 200 ug/m^3 (0.025 ppm)
Water, Health: 5 x 1 = 5 μg/ℓ
Land, Health: 0.002 x 5 = 0.01 μg/g

Air, Ecology:
Water, Ecology: 5 x 100 = 500 μg/ℓ
Land, Ecology: 0.002 x 500 = 1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.2/420 = 0.5\ \mu g/m^3$
$EPC_{AH1a} = 0.025/420 = 6 \times 10^{-5}$ ppm
$EPC_{WH1} = 15 \times 0.5 = 7.5\ \mu g/\ell$
$EPC_{WH2} = 13.8 \times 0.2 = 3\ \mu g/\ell$
$EPC_{WHS} = 1\ \mu g/\ell$ (phenolic compounds)
$EPC_{LH} = 0.002 \times 1 = 0.002\ \mu g/g$

$EPC_{WE1} = 50 \times 1 = 50\ \mu g/\ell$
$EPC_{WES} = 100\ \mu g/\ell$ (phenolic compounds)
$EPC_{LE} = 0.002 \times 50 = 0.1\ \mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.0E2 (0.025)		0.5 ($6x10^{-5}$)		
Water, $\mu g/l$ (ppm Wt)			5.0E0	5.0E2	1	50	
Land, $\mu g/g$ (ppm Wt)			1.0E-2	1.0E0	0.002	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.5 ($6x10^{-5}$)		
Water, $\mu g/l$ (ppm Wt)	1†	100†	3	50	
Land, $\mu g/g$ (ppm Wt)			0.002	0.1	

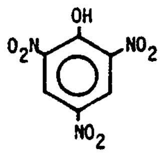
†Phenolic compounds.

CATEGORY: 20

WLN: WNR BQ CNW ENW

2,4,6-TRINITROPHENOL: $C_6H_3N_3O_7$ (picric acid).
Yellow crystals; odorless.

STRUCTURE:



PROPERTIES:

Molecular wt: 229.11; mp: 121.8; explodes above 300°; d: 1.763; vap. d: 7.90; slightly soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Picric acid is a hazardous chemical. It is a known explosive. It reacts with metals to form picrates, which are also explosive.

Nitrophenols are formed by the reaction of nitric acid with phenols.

TOXIC PROPERTIES, HEALTH EFFECTS:

Picric acid is a strong acid ($K_A \doteq 10^{-1}$).

Contact of picric acid with the skin may cause irritation, burns, or allergic reactions (ref. 24).

Picric acid is absorbed through the skin. Ingestion of 1 to 2 grams in man causes severe poisoning (ref. 4).

LD_{Lo} (unknown route of administration, dog): 60 mg/kg.

LD_{Lo} (oral, rabbit): 120 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.1 mg/m^3 (0.01 ppm).

EPA 1976 Water Quality Criteria (proposed): 1 μg/ℓ of phenol (including phenolic compounds) for domestic water supply (welfare) and to protect against fish flesh tainting (ref. 33).

NAS/NAE 1972 Water Quality Criteria: 1 μg/ℓ of phenolic compounds in public water supply sources to prevent odor from chlorinated phenols. To prevent tainting and toxic effects in aquatic life: Concentration no greater than 100 μg/ℓ at any time or place; application factor of 0.05 (for phenols) (ref. 28).

U.S. Public Health Service Drinking Water Regulations, 1962--Levels for alternate source selection: 1 μg/ℓ (for phenols) (ref. 66).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 100 μg/m^3 (0.011 ppm)
Water, Health: 5 x 1 = 5 μg/ℓ
Land, Health: 0.002 x 5 = 0.01 μg/g

Air, Ecology:
Water, Ecology: 5 x 100 = 500 μg/ℓ
Land, Ecology: 0.002 x 500 = 1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.1/420 = 0.24$ μg/m^3
$EPC_{AH1a} = 0.011/420 = 2.6 \times 10^{-5}$ ppm
$EPC_{WH1} = 15 \times 0.24 = 3.6$ μg/ℓ
$EPC_{WH2} = 13.8 \times 0.1 = 1.4$ μg/ℓ
$EPC_{WHS} = 1$ μg/ℓ (phenolic compounds)
$EPC_{LH} = 0.002 \times 1 = 0.002$ μg/g

$EPC_{WES} = 100$ μg/ℓ (phenolic compounds)
$EPC_{LE} = 0.002 \times 100 = 0.2$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E2 (0.011)		0.24 (2.6E-5)		
Water, $\mu g/l$ (ppm Wt)			5.0E0	5.0E2	1	100	
Land, $\mu g/g$ (ppm Wt)			1.0E-2	1.0E0	0.002	0.2	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.24 (2.6x10-5)		
Water, $\mu g/l$ (ppm Wt)	1†	100†	1.4		
Land, $\mu g/g$ (ppm Wt)			0.002	0.2	

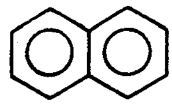
†Phenolic compounds.

CATEGORY: 21

WLN: L66J

NAPHTHALENE: $C_{10}H_8$ (moth flakes, naphthalin, naphthaline, naphthene, tar camphor, white tar).
Colorless monoclinic crystals, aromatic odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 128.18 mp: 80.55, bp: 218, 87.5^{10}; d: 1.0253^{20}, 0.9625_4^{1000}; vap. press: 1 mm at 52.6° C; vap.d: 4.42; very low solubility in water; solubility may be enhanced by surfacant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Naphthalene is among the lower molecular weight polycyclic hydrocarbons comprising the volatile portion of the benzene-soluble fraction of coal tar (ref. 4). Concentrations of 3.8 to 11.2 $\mu g/m^3$ in urban air are reported (ref. 1). Naphthalene is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The following concentrations of PPAH have been estimated or reported: Air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); groundwater and surface treated water: 0.001 µg/ℓ - 0.025 µg/ℓ (ref. 58); upper layer of Earth's crust: 100 µg/kg - 1,000 µg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

LD_{50} (oral, rat): 1,780 mg/kg.
Naphthalene may cause irritation in concentrations of 15 ppm, and serious damage to eyes may result from continuous exposure (ref. 4).

Naphthalene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59). Naphthalene is included in the NIOSH Suspected Carcinogen List. The EPA/NIOSH ordering number is 4101. The lowest dose to induce an oncogenic response is reported as 3,500 mg/kg. The adjusted ordering number is 1.17. Naphthalene is considered inactive as a carcinogen (ref. 59).

Naphthalene has been rated as moderately toxic to aquatic organisms. The 96-hour TLm is reported as 1-10 ppm (ref. 2). Naphthalene in concentrations of 1 mg/ℓ may cause tainting of fish flesh (refs. 28, 69).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Naphthalene appears on EPA Consent Decree List with an assigned priority of 2.
TLV: 50 mg/m^3 (10 ppm)
TLV for coal-tar pitch: 0.2 mg/m^3 [The specification includes naphthalene, anthracene, acridine, phenanthrene, and fluorene collectively. The purpose of the TLV is to minimize concentrations of higher weight polycyclic hydrocarbons which are carcinogenic (ref. 4).]

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 5.0×10^4 $\mu g/m^3$ (10 ppm)
Water, Health: $15 \times 5.0 \times 10^4 = 7.5 \times 10^5$ µg/ℓ
Land, Health: $0.002 \times 7.5 \times 10^5 = 1.5 \times 10^3$ µg/g

Air, Ecology:
Water, Ecology: $100 \times 1 = 100$ µg/ℓ
Land, Ecology: $0.002 \times 100 = 0.2$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 50/420 = 119$ $\mu g/m^3$
$EPC_{AH1a} = 10/420 = 0.02$ ppm
$EPC_{WH1} = 15 \times 119 = 1,785$ µg/ℓ
$EPC_{WH2} = 13.8 \times 50 = 690$ µg/ℓ
$EPC_{LH} = 0.002 \times 690 = 1.38$ µg/g
$EPC_{AC2} = 10^3/(6 \times 1.17) = 142$ $\mu g/m^3$
$EPC_{WC} = 15 \times 142 = 2,130$ µg/ℓ
$EPC_{LC} = 0.002 \times 2,130 = 4.26$ µg/g

$EPC_{WE1} = 50 \times 1 = 50$ µg/ℓ
$EPC_{WE2} = 1,000$ µg/ℓ (to prevent tainting)
$EPC_{LE} = 0.002 \times 50 = 0.1$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			5.0E4 (10)		119 (0.02)		3.8-11.2†
Water, μg/l (ppm Wt)			7.5E5	1.0E2	690	50	
Land, μg/g (ppm Wt)			1.5E3	2.0E-1	1.38	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			119 (0.02)		142
Water, μg/l (ppm Wt)			690	50	2,130
Land, μg/g (ppm Wt)			1.38	0.1	4.26

†Reported for urban atmosphere. No rural concentration is reported.

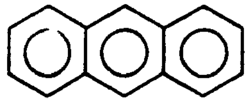
CATEGORY: 21

WLN: L C666J

ANTHRACENE: $C_{14}H_{10}$

Colorless, monoclinic plates (when pure) with violet fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt: 178; mp: 216.2-216.4; bp: 340, 226.5^{53}; d: 1.283^{25}; vap.press.: 1 mm at 145.0° C; sublimes; vap. d: 6.15; insoluble in water, solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Anthracene is among the lower molecular weight polycyclic hydrocarbons comprising the volatile portion of the benzene-soluble fraction of coal tar (ref. 4). Concentrations of 0.5252 μg/1,500 m^3 and 2 μg/1,000 m^3 in urban air are reported (ref. 1). This is equivalent to 0.00035 to 0.002 μg/m^3. Anthracene is associated with particulate polycyclic aromatic hydrocarbons, PPAH, (ref. 71). The following concentrations of PPAH have been estimated or reported: Air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); ground-water and surface-treated water: 0.001 μg/ℓ - 0.025 μg/ℓ (ref. 58); upper layer of Earth's crust: 100 μg/kg - 1,000 μg/kg (ref. 58). upper layer of Earth's crust: 100 μg/kg - 1,000 μg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

No specific information is available relative to acute toxic properties of anthracene. Anthracene may be present in soot, coal-tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59). Anthracene is included in the NIOSH Suspected Carcinogen List. The EPA/NIOSH ordering number is 4112. The lowest dose to induce an oncogenic response is reported as 3,300 mg/kg. The adjusted ordering number is 1.25.

Anthracene is considered inactive as a carcinogen (ref. 59).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Anthracene appears on EPA Consent Decree List with an assigned priority of 1.
TLV (coal tar pitch volatiles): 0.2 mg/m^3. [The specification includes naphthalene, anthracene, acridine, phenathrene, and fluorene, collectively. The purpose of the TLV is to minimize concentrations of higher-weight polycyclic hydrocarbons which are carcinogenic (ref. 4).]

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/1.25 = 5.6 \times 10^4$ μg/m^3
Water, Health: $15 \times 5.6 \times 10^4 = 8.4 \times 10^5$ μg/ℓ
Land, Health: $0.002 \times 8.4 \times 10^5 = 1.68 \times 10^3$ μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 1.25) = 133$ μg/m^3
$EPC_{WC} = 15 \times 133 = 1{,}995$ μg/ℓ
$EPC_{LC} = 0.002 \times 1{,}995 = 4.0$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.6E4		133		0.00035-0.002†
Water, $\mu g/l$ (ppm Wt)			8.4E5		2,000		
Land, $\mu g/g$ (ppm Wt)			1.68E3		4.0		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					133
Water, $\mu g/l$ (ppm Wt)					2,000
Land, $\mu g/g$ (ppm Wt)					4.0

†Reported for urban atmosphere. No rural concentration is reported.

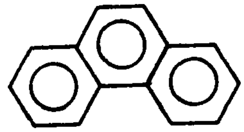
CATEGORY: 21

WLN: LB666J

PHENANTHRENE: $C_{14}H_{10}$.

Monoclinic crystals from alcohol; solutions exhibit faint blue fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt: 178; mp: 101; bp: 340; d: 0.9800^4; vap. press.: 1 mm at 118.3; vap. d: 6.14; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58); lipid solubility: 2 percent solution in olive oil (ref. 72).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Phenanthrene is among the lower molecular weight polycyclic hydrocarbons comprising the volatile portion of the benzene-soluble fraction of coal tar (ref. 4). Concentrations of 0.6102 μg/1,500 m^3 and 6 μg/1,000 m^3 in urban air are reported (ref. 1). This is equivalent to 0.0004 to 0.006 μg/m^3. Phenanthrene is associated with particulate polycyclic aromatic hydrocarbons, PPAH, (ref. 71). The following concentrations of PPAH have been estimated or reported: Air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); groundwater and surface-treated water: 0.001 μg/ℓ - 0.025 μg/ℓ (ref. AAS); upper layer of Earth's crust: 100 μg/kg - 1,000 μg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

LD_{50} (oral, mouse): 700 mg/kg.

Phenanthrene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59). Phenanthrene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3121. The lowest dose to induce an oncogenic response is reported as 71 mg/kg. The adjusted ordering number is 44.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Phenanthrene appears on EPA Consent Decree List with an assigned priority of 1.

TLV (coal-tar pitch volatiles): 0.2 mg/m^3. [The specification includes naphthalene, anthracene, acridine, phenanthrene, and fluorene, collectively. The purpose of the TLV is to minimize concentrations of higher weight polycyclic hydrocarbons which are carcinogenic (ref. 4)].

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/44 = 1.59 \times 10^3$ μg/m^3

Water, Health: $15 \times 1.59 \times 10^3 = 2.39 \times 10^4$ μg/ℓ

Land, Health: $0.002 \times 2.39 \times 10^4 = 47.8$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 700 = 75$ μg/m^3

$EPC_{AH3} = 0.081 \times 700 = 57$ μg/m^3

$EPC_{WH1} = 15 \times 57 = 855$ μg/ℓ

$EPC_{WH2} = 0.4 \times 700 = 280$ μg/ℓ

$EPC_{LH} = 0.002 \times 280 = 0.56$ μg/g

$EPC_{AC2} = 10^3/(6 \times 44) = 3.8$ μg/m^3

$EPC_{WC} = 15 \times 3.8 = 57$ μg/ℓ

$EPC_{LC} = 0.002 \times 57 = 0.114$ μg/g

EMISSION LEVEL GOALS								
	I. Based on Best Technology		II. Based on Ambient Factors					
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.59E3		3.8		
Water, $\mu g/l$ (ppm Wt)			2.39E4		57		
Land, $\mu g/g$ (ppm Wt)			4.8E1		0.114		

*To be multiplied by dilution factor

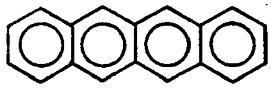
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			57		3.8
Water, $\mu g/l$ (ppm Wt)			280		57
Land, $\mu g/g$ (ppm Wt)			0.56		0.114

CATEGORY: 21

WLN: L E6 C666J

NAPHTHACENE: $C_{18}H_{12}$(2,3-benzanthracene, tetracene, chrysogen)
Crystallizes from xylene in orange leaflets;
solutions show slight green fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt: 228.28; mp: 341; sublimes in vacuo; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Naphthacene occurs in coal tar.

TOXIC PROPERTIES, HEALTH EFFECTS:

Naphthacene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59). Naphthacene is considered inactive as a carcinogen (ref. 59).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health:
Water, Health:
Land, Health:

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)							
Water, $\mu g/l$ (ppm Wt)							
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

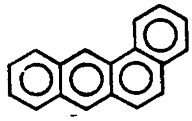
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					
Water, $\mu g/l$ (ppm Wt)					
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 21

WLN: L D6 B666J

BENZ(a)ANTHRACENE: $C_{18}H_{12}$ (benzo(b)phenanthrene, 1,2-benzanthracene, 2,3-benzophenanthrene, BA). Crystallizes in the form of plates from ethanol. Solutions exhibit greenish-yellow fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt.: 228.28; mp: 158-9; bp: 400° C; sublimes; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58); lipid solubility: 0.6 mg/0.2 ml neutral, sterile olive oil (ref. 72).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Benz(a)anthracene occurs in coal tar and is associated with particulate polycyclic aromatic hydrocarbons, PPAH. The lowest urban air concentration reported for benz(a)anthracene is 44.69 $\mu g/m^3$ (ref. 1). This is equivalent to 0.029 $\mu g/m^3$.

Concentrations of BA in soils (nonindustrial areas) ranging from 5-20 µg/kg have been reported (ref. 73).

Other concentrations of BA are reported as follows: (a) drinking water - 23.2 $\mu g/m^3$; (b) cooked meat or fish - 189 µg/kg; (c) vegetables - 230 µg/kg; (d) roasted coffee - 14.2 µg/kg (ref. 73).

TOXIC PROPERTIES, HEALTH EFFECTS:

LD_{Lo} (intravenous, mouse): 10 mg/kg.

Benz(a)anthracene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59). Benz(a)anthracene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3124. The lowest dose to induce a carcinogenic response is reported as 2 mg/kg. The adjusted ordering number is 1562.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 [for particulate polycyclic aromatic hydrocarbons (PPAH). This TLV recognizes the carcinogenic potential of PPAH collectively].

Benz(a)anthracene appears on the EPA Consent Decree List with an assigned priority of 1.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/1{,}562 = 44.8\ \mu g/m^3$	Air, Ecology:
Water, Health: $15 \times 44.8 = 672\ \mu g/\ell$	Water, Ecology:
Land, Health: $0.002 \times 672 = 1.34\ \mu g/g$	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 10 = 1.07\ \mu g/m^3$
$EPC_{AH3} = 0.081 \times 10 = 0.81\ \mu g/m^3$
$EPC_{WH1} = 15 \times 0.81 = 12.2\ \mu g/\ell$
$EPC_{WH2} = 0.4 \times 10 = 4.0\ \mu g/\ell$
$EPC_{LH} = 0.002 \times 4 = 0.008\ \mu g/g$
$EPC_{AC2} = 10^3/(6 \times 1{,}562) = 0.11\ \mu g/m^3$
$EPC_{WC} = 15 \times 0.11 = 1.65\ \mu g/\ell$
$EPC_{LC} = 0.002 \times 1.65 = 0.003\ \mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.5E1		0.11		0.029†
Water, $\mu g/l$ (ppm Wt)			6.7E2		1.65		0.023‡
Land, $\mu g/g$ (ppm Wt)			1.3E0		0.003		0.02

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.81		0.11
Water, $\mu g/l$ (ppm Wt)			4.0		1.65
Land, $\mu g/g$ (ppm Wt)			0.008		0.003

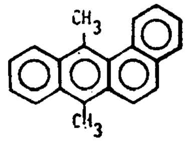
†Reported for urban air. No rural concentration is reported.

‡Drinking water.

CATEGORY: 21

WLN: L D6 B666J CJ

STRUCTURE:



7,12-DIMETHYLBENZ(a)ANTHRACENE: $C_{20}H_{16}$, (9,10-dimethyl-1,2-benzanthracene, DMBA).
Crystalizes as greenish-yellow plates from acetone-alcohol, maximum fluorescence at 440 nm.

PROPERTIES:

Molecular wt.: 256.33; mp: 122-123; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58), and by purines such as caffeine (ref. 24); lipid solubility: 50 mg/ml in tributyrin (ref. 74).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Although 7,12-dimethylbenz(a)anthracene has not been positively identified in products of coal pyrolysis, the molecular weight fraction corresponding to the compound has been isolated. It is generally presumed to be associated with particulate polycyclic aromatic hydrocarbons and with coal tar.

TOXIC PROPERTIES, HEALTH EFFECTS:

LD_{50} (oral,mouse): 340 mg/kg.
7,12-Dimethylbenz(a)anthracene is known to be highly carcinogenic in experimental animals (ref. 59). Experimental evidence also indicates that it is a teratogenic agent in rats (ref. 75). 7,12-Dimethylbenz(a)anthracene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number based on carcinogenicity is 5,729. The lowest dose to induce a carcinogenic response is 21 μg/kg, and the adjusted ordering number is 272,809. The EPA/NIOSH ordering number based on teratogenicity is 4,102, with the lowest dosage being 20 mg/kg. The adjusted ordering number is 205.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively.)

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/272{,}809 = 0.26\ \mu g/m^3$
Water, Health: $15 \times 0.26 = 3.9\ \mu g/\ell$
Land, Health: $0.002 \times 3.9 = 0.008\ \mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 340 = 36.4\ \mu g/m^3$
$EPC_{AH3} = 0.081 \times 340 = 27.5\ \mu g/m^3$
$EPC_{WH1} = 15 \times 27.5 = 413\ \mu g/\ell$
$EPC_{WH2} = 0.4 \times 340 = 136\ \mu g/\ell$
$EPC_{LH} = 0.002 \times 136 = 0.27\ \mu g/g$
$EPC_{AC2} = 10^3/(6 \times 272{,}809) = 0.0006\ \mu g/m^3$
$EPC_{WC} = 15 \times 0.006 = 0.009\ \mu g/\ell$
$EPC_{LC} = 0.002 \times 0.009 = 1.8 \times 10^{-5}\ \mu g/g$

$EPC_{AT} = 10^3/(6 \times 205) = 0.8\ \mu g/m^3$
$EPC_{WT} = 15 \times 0.8 = 12\ \mu g/\ell$
$EPC_{LT} = 0.002 \times 12 = 0.024\ \mu g/g$

7, 12-DIMETHYLBENZ(a)ANTHRACENE

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.6E-1		0.0006		
Water, $\mu g/l$ (ppm Wt)			3.9E0		0.009		
Land, $\mu g/g$ (ppm Wt)			8.0E-3		1.8×10^{-5}		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

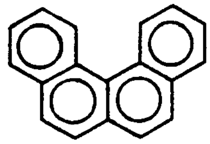
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			27.5		0.0006
Water, $\mu g/l$ (ppm Wt)			136		0.009
Land, $\mu g/g$ (ppm Wt)			0.27		1.8×10^{-5}

CATEGORY: 21

WLN: L C6 B666J

BENZO(c)PHENANTHRENE: $C_{18}H_{12}$ (3,4-benzophenanthrene).
Crystallizes in the form of needles from ethanol.

STRUCTURE:



PROPERTIES:

Molecular wt: 228.30; mp: 68; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The urban air concentration for benzo(c)phenanthrene is reported as 9.781 μg/1,500 m^3 (ref. 1). This is equivalent to 6.5 ng/m^3. The compound probably occurs as a constituent of particulate polycyclic aromatic hydrocarbons, PPAH.

TOXIC PROPERTIES, HEALTH EFFECTS:

Although not considered to be a highly active carcinogen alone, benzo(c)phenanthrene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3121. The lowest dose to induce a carcinogenic response is reported as 1,220 mg/kg. The adjusted ordering number is 2.56.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively.)

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/2.56 = 2.73 \times 10^4$ μg/m^3
Water, Health: $15 \times 2.73 \times 10^4 = 4.1 \times 10^5$ μg/ℓ
Land, Health: $0.002 \times 4.1 \times 10^5 = 820$ μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 2.5) = 66.7$ μg/m^3
$EPC_{WC} = 15 \times 66.7 = 1,000$ μg/ℓ
$EPC_{LC} = 0.002 \times 100 = 2.0$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.73E4		66.7		0.0065†
Water, $\mu g/l$ (ppm Wt)			4.1E5		1,000		
Land, $\mu g/g$ (ppm Wt)			8.20E2		2.0		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

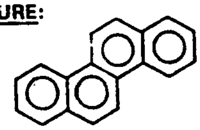
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					66.7
Water, $\mu g/l$ (ppm Wt)					1,000
Land, $\mu g/g$ (ppm Wt)					2.0

†Reported for urban atmosphere. No rural concentration is reported.

CATEGORY: 21

WLN: L E6 B666J

STRUCTURE:



CHRYSENE: $C_{18}H_{12}$ (1,2-benzophenanthrene, benz(a)-phenanthrene).

Crystallizes in the form of plates; solutions and crystals exhibit blue fluorescence.

PROPERTIES:

Molecular wt: 228.28; mp: 255-256; sublimes in vacuo; bp: 448; d: 1.274^{20}; insoluble in water, solubility may be enhanced by surfactant impurities in water (ref. 58); lipid solubility: 7.5 percent solution in olive oil (ref. 73).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Chrysene occurs in coal tar, is formed during distillation of coal, and is a product of pyrolysis of many fats and oils. Chrysene is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71).

Environmental concentrations of chrysene are reported as follows: urban air--0.023 mg/m^3 (ref. 1); surface water--11.8-38.2 μg/m^3; sand--15 μg/kg (ref. 73).

Maximum concentrations of chrysene in foods are also reported: cooked meat or fish--173 μg/kg; vegetables--395 μg/kg; roasted coffee--19.1 μg/kg (ref. 73).

TOXIC PROPERTIES, HEALTH EFFECTS:

Chrysene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59). Chrysene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3122. The lowest dose to induce an oncogenic response is reported as 99 mg/kg. The adjusted ordering number is 31.5.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Chrysene appears on the EPA Consent Decree List with an assigned priority of 1.

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/31.5 = 2.22 \times 10^3$ μg/m^3	Air, Ecology:
Water, Health: $15 \times 2.22 \times 10^3 = 3.33 \times 10^4$ μg/ℓ	Water, Ecology:
Land, Health: $0.002 \times 3.33 \times 10^4 = 66.6$ μg/g	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 31.5) = 5.29$ μg/m^3

$EPC_{WC} = 15 \times 5.29 = 79.4$ μg/ℓ

$EPC_{LC} = 0.002 \times 79.4 = 0.16$ μg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.22E3		5.29		2.3×10^{-5}†
Water, $\mu g/l$ (ppm Wt)			3.33E4		79.4		0.01 to 0.04
Land, $\mu g/g$ (ppm Wt)			6.6E1		0.16		0.015

*To be multiplied by dilution factor

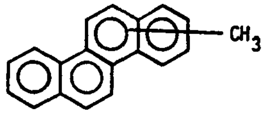
	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					5.29
Water, $\mu g/l$ (ppm Wt)					79.4
Land, $\mu g/g$ (ppm Wt)					0.16

†Reported for urban air. No rural concentration is reported.

CATEGORY: 21

WLN:

STRUCTURE:



METHYL CHRYSENES: $C_{19}H_{14}$ (methyl-1,2-benzophenanthrene).
The 4-methyl and 5-methyl chrysenes exhibit fluorescence.

PROPERTIES:

Molecular wt: 242; mp: 117-254; insoluble in water;
solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Methyl chrysenes are associated with particulate polycyclic aromatic hydrocarbons and with coal tar. The urban-air concentration for methyl chrysenes is reported as 6.195 $\mu g/1500\ m^3$ (ref. 1). This is equivalent to 4.1 ng/m^3. Methyl chrysenes have also been detected in the polycyclic aromatic hydrocarbon fraction of marine sediments (ref. 76).

TOXIC PROPERTIES, HEALTH EFFECTS:

Methyl chrysenes may be present in soot, coal tar, oils, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59). Five methyl chrysenes are listed in the NIOSH Suspected Carcinogens List. The collective EPA/NIOSH ordering number for the five compounds is 3123. The lowest dose to induce an oncogenic response is reported as 80 mg/kg. The adjusted ordering number for the methyl chrysenes collectively is 39.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/39 = 1.79 \times 10^3\ \mu g/m^3$	Air, Ecology:
Water, Health: $15 \times 1.79 \times 10^3 = 2.69 \times 10^4\ \mu g/\ell$	Water, Ecology:
Land, Health: $0.002 \times 2.69 \times 10^4 = 53.8\ \mu g/g$	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 39) = 4.3\ \mu g/m^3$
$EPC_{WC} = 15 \times 4.3 = 64.5\ \mu g/\ell$
$EPC_{LC} = 0.002 \times 64.5 = 0.129\ \mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.8E3		4.3		0.004†
Water, $\mu g/l$ (ppm Wt)			2.7E4		64.5		
Land, $\mu g/g$ (ppm Wt)			5.4E1		0.13		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					4.3
Water, $\mu g/l$ (ppm Wt)					64.5
Land, $\mu g/g$ (ppm Wt)					0.13

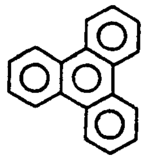
†Reported for urban atmosphere. No rural concentration is reported.

CATEGORY: 21

WLN: L B6 H666J

TRIPHENYLENE: $C_{18}H_{12}$ (1,2-3,4-dibenznaphthalene).
Crystallizes in the form of long needles; solutions exhibit blue fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt: 228.28; mp: 199; sublimes; bp: 425; d: 1.302; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Triphenylene occurs to a small extent in coal tar.

TOXIC PROPERTIES, HEALTH EFFECTS:

Triphenylene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59).

Triphenylene is considered inactive as a carcinogen (ref. 59).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 [for particulate polycyclic aromatic hydrocarbons (PPAH). This TLV recognizes the carcinogenic potential of PPAH collectively.]

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health:
Water, Health:
Land, Health:

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)							
Water, $\mu g/l$ (ppm Wt)							
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

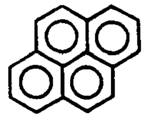
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					
Water, $\mu g/l$ (ppm Wt)					
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 21

WLN: L666 B6 2AB PJ

PYRENE: $C_{16}H_{10}$ (benzo(def)phenanthrene).
Crystallizes as pale yellow plates; solutions show slight blue fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt: 202; mp: 149-50; sublimes; bp: > 360; d: 1.271^{23}_{4}; insoluble in water; solubility may be inhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Pyrene occurs in coal tar. It is also obtained by the destructive hydrogenation of hard coal. The lowest reported concentration of pyrene in urban areas is 0.45 mg/m^3 (ref. 1). This is equivalent to 450 μg/m^3.

Pyrene is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The following concentrations of carcinogenic PPAH have been estimated or reported: air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); ground-water and surface-treated water: 0.001 μg/ℓ - 0.025 μg/ℓ (ref. 58); upper layer of earth's crust: 100 μg/kg - 1,000 μg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

Pyrene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59). Although not considered a highly active carcinogen alone, pyrene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3121. The lowest toxic dose reported to produce an oncogenic response is 10 g/kg. This is equivalent to 10,000 mg. The adjusted ordering number is 0.3.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Pyrene appears on the EPA Consent Decree List with an assigned priority of 1.

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/0.3 = 2.3 \times 10^5$ μg/m^3
Water, Health: $15 \times 2.3 \times 10^5 = 3.45 \times 10^6$ μg/ℓ
Land, Health: $0.002 \times 3.45 \times 10^6 = 6.9 \times 10^3$ μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 0.3) = 555.6$ μg/m^3
$EPC_{WC} = 15 \times 555.6 = 8,333$ μg/ℓ
$EPC_{LC} = 0.002 \times 833 = 16.7$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.3E5		555.6		450†
Water, $\mu g/l$ (ppm Wt)			3.45E6		8,333		
Land, $\mu g/g$ (ppm Wt)			6.9E3		16.7		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					555.6
Water, $\mu g/l$ (ppm Wt)					8,333
Land, $\mu g/g$ (ppm Wt)					16.7

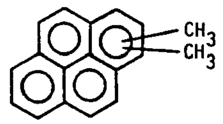
†Reported for urban atmosphere. No rural concentration is reported.

CATEGORY: 21

WLN:

DIMETHYL PYRENES: $C_{18}H_{14}$ (3,4 and 4,5-dimethylpyrenes). Crystallize in the form of plates from petroleum ether.

STRUCTURE:



PROPERTIES:

Molecular wt: 232; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Alkyl pyrenes have been isolated from coal tar and from soot (ref. 77).

Dimethyl pyrenes are associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The following concentrations of carcinogenic PPAH have been estimated or reported: Air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); ground-water and surface-treated water: 0.001 µg/ℓ - 0.025 µg/ℓ (ref. 58): upper layer of Earth's crust: 100 µg/kg - 1,000 µg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

Dimethyl pyrenes may be present in soot, coal tar, and pitch which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59). There is no evidence to indicate that the dimethy pyrenes alone are carcinogenic.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 [for particulate polycyclic aromatic hydrocarbons (PPAH). This TLV recognizes the carcinogenic potential of PPAH collectively].

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health:
Water, Health:
Land, Health:

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EMISSION LEVEL GOALS								
	I. Based on Best Technology		II. Based on Ambient Factors					
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)							
Water, $\mu g/l$ (ppm Wt)							
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

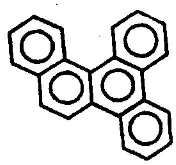
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					
Water, $\mu g/l$ (ppm Wt)					
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 21

WLN: L C6 I6 B666J

BENZO(g)CHRYSENE: $C_{22}H_{14}$ (1,2-3,4-dibenzophenanthrene).
Crystallizes as colorless needles from glacial acetic acid.

STRUCTURE:



PROPERTIES:

Molecular wt: 278.36; mp: 114.5; bp: 135; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Benzo(g)chrysene probably occurs as a constituent of particulate polycyclic aromatic hydrocarbons, PPAH.

TOXIC PROPERTIES, HEALTH EFFECTS:

Although not considered to be a highly active carcinogen alone, benzo(g)chrysene is included on the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3123. The lowest dose to induce a carcinogenic response is reported as 720 mg/kg. The adjusted ordering number is 4.34.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 [for particulate polycyclic aromatic hydrocarbons (PPAH). This TLV recognizes the carcinogenic potential of PPAH collectively.]

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4 \times 4.34 = 1.6 \times 10^4$
Water, Health: $15 \times 1.6 \times 10^4 = 2.42 \times 10^5$
Land, Health: $0.002 \times 2.42 \times 10^5 = 4.84$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 4.34) = 38.4\ \mu g/m^3$
$EPC_{WC} = 15 \times 38.4 = 576\ \mu g/\ell$
$EPC_{LC} = 0.002 \times 576 = 1.15\ \mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.6E4		38.4		
Water, $\mu g/l$ (ppm Wt)			2.42E5		576		
Land, $\mu g/g$ (ppm Wt)			4.8E2		1.15		

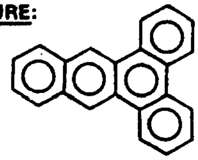
*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					38.4
Water, $\mu g/l$ (ppm Wt)					576
Land, $\mu g/g$ (ppm Wt)					1.15

CATEGORY: 21

WLN: L D6 J6 C666J

STRUCTURE:



DIBENZ(a,c)ANTHRACENE: $C_{22}H_{14}$ (1,2-3,4-dibenzanthracene, benzo(b)triphenylene).

Crystallizes as colorless needles from ethanol; solutions show blue fluorescence.

PROPERTIES:

Molecular wt: 278.22; mp: 200-2; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58); lipid solubility: 0.6 mg in 0.2 ml olive oil (ref. 78).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Dibenz(a,c)anthracene is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The following concentrations of PPAH have been estimated or reported: air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); ground-water and surface-treated water: 0.001 μg/ℓ - 0.025 μg/ℓ (ref. 58); upper layer of earth's crust: 100 μg/kg - 1,000 μg/kg (ref. 58).

The concentration of dibenz(a,c)anthracene in urban air is reported as 13,348 μg/1,500 m^3 (ref. 1). This is equivalent to 0.88 ng/m^3.

TOXIC PROPERTIES, HEALTH EFFECTS:

Dibenz(a,c)anthracene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59).

Dibenz(a,c)anthracene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3121. The lowest dose to induce a carcinogenic response is 440 mg/kg. The adjusted ordering number is 7.09. There is disagreement regarding the carcinogenicity of dibenz(a,c)anthracene (ref. 59).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/7.09 = 9.9 \times 10^3$ μg/m^3

Water, Health: $15 \times 9.9 \times 10^3 = 1.5 \times 10^5$ μg/ℓ

Land, Health: $0.002 \times 1.5 \times 10^5 = 300$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 7.09) = 23.5$ μg/m^3

$EPC_{WC} = 15 \times 23.5 = 353$ μg/ℓ

$EPC_{LC} = 0.002 \times 353 = 0.7$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			9.9E3		23.5		0.0009†
Water, $\mu g/l$ (ppm Wt)			1.5E5		353		
Land, $\mu g/g$ (ppm Wt)			3.0E2		0.7		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					23.5
Water, $\mu g/l$ (ppm Wt)					353
Land, $\mu g/g$ (ppm Wt)					0.7

†Reported for urban atmosphere. No rural concentration is reported.

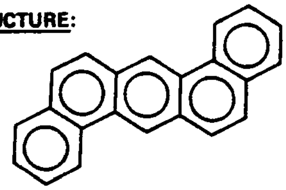
CATEGORY: 21

WLN:

DIBENZ(a,h)ANTHRACENE: $C_{22}H_{14}$ (1,2-5,6-dibenzanthracene, DB(a,h)A).

Crystallizes in the form of silvery leaflets from acetic acid.

STRUCTURE:



PROPERTIES:

Molecular wt: 278.33; mp: 262; sublimes; solubility in water: 0.0005 mg/ℓ at 27° (ref. 73); lipid solubility: 8 mg/ml in tributyrin (ref. 74).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Environmental concentration of DB(a,h)A are reported as follows: urban air--3.2-32 μg/1,000 m^3; soils (Iceland)--0-2.3 μg/kg (ref. 73). DB(a,h)A has also been detected in cooked meats and vegetables (ref. 73). The compound is probably a constituent of particulate polycyclic aromatic hydrocarbons, PPAH.

TOXIC PROPERTIES, HEALTH EFFECTS:

LD_{Lo} (intravenous, mouse): 10 mg/kg.

Dibenz(a,h)anthracene may be present in soot, coal tar, and pitch which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59). DB(a,h)A is considered an active carcinogen and causes aberrations in mammalian cells (ref. 42). It is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 4529. The lowest dose to induce an oncogenic response is reported as 0.006 mg/kg. The adjusted ordering number is 754,833.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Dibenz(a,h)anthracene appears on EPA Consent Decree List with an assigned priority of 1.

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/754{,}833 = 0.093$ μg/m^3

Water, Health: $15 \times 0.093 = 1.4$ μg/ℓ

Land, Health: $0.002 \times 1.4 = 0.003$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 10 = 1.07$ μg/m^3

$EPC_{AH3} = 0.081 \times 10 = 0.81$ μg/m^3

$EPC_{WH1} = 15 \times 0.81 = 12.2$ μg/ℓ

$EPC_{WH2} = 0.4 \times 10 = 4.0$ μg/ℓ

$EPC_{LH} = 0.002 \times 4.0 = 0.008$ μg/g

$EPC_{AC2} = 10^3/(6 \times 754{,}833) = 0.0002$ μg/m^3

$EPC_{WC} = 15 \times 0.0002 = 0.003$ μg/ℓ

$EPC_{LC} = 0.002 \times 0.003 = 6 \times 10^{-6}$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			9.3E-2		0.0002		0.0032 to 0.032†
Water, $\mu g/l$ (ppm Wt)			1.4E0		0.003		0 to 0.0023
Land, $\mu g/g$ (ppm Wt)			3.0E-3		6×10^{-6}		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.81		0.0002
Water, $\mu g/l$ (ppm Wt)			4.0		0.003
Land, $\mu g/g$ (ppm Wt)			0.008		6×10^{-6}

†Reported for urban atmosphere. No rural concentration is reported.

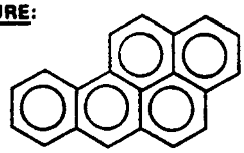
CATEGORY: 21

WLN: L D6 B6666 2AB -TJ

BENZO(a)PYRENE: $C_{20}H_{12}$ (1,2-benzpyrene, B(a)P

Yellowish plates; benzene solutions exhibit violet fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt: 252.30; mp: 179; bp: 496-510; vap. press: 10 mm at 310-312°C; insoluble in water, solubility may be enhanced by surfactant impurities in water (ref. 58); lipid solubility: 25 mg/ml in tributyrin (ref. 79).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Benzo(a)pyrene occurs in coal tar and in all kinds of soot and smoke. Environmental concentration of B(a)P is reported as follows: urban air--0.04-0.4 μg/1,000 m^3 (refs. 1,3); forest, woods, sand (nonindustrial areas)--0-127 μg/kg (ref. 73). Other maximum concentrations reported include: drinking water--23.4 μg/m^3; cooked meat or fish--107 μg/kg; vegetables--8 μg/kg; roasted coffee--15 μg/kg (ref. 73).

The chemical half-life of benzo(a)pyrene in the atmosphere is reported as less than 1 day with solar radiation and several days without solar radiation (ref. 8). Benzo(a)pyrene is associated with particulate polycyclic aromatic hydrocarbons, PPAH.

TOXIC PROPERTIES, HEALTH EFFECTS:

LD_{50} (subcutaneous, rat): 50 mg/kg.

Benzo(a)pyrene is considered to be an active carcinogen. It has been shown to cause chromosome aberrations in mammalian cells (ref. 42). Experimental evidence indicates that B(a)P is a mutagenic and teratogenic agent in the mouse (ref. 2). Benzo(a)pyrene appears in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number based on carcinogenic responses, is 6629. The lowest dose to induce a carcinogenic response is reported as 2 μg/kg. The adjusted number is 3,314,500 based on carcinogenicity. The EPA/NIOSH ordering number based on teratogenicity is 3102. The lowest dose resulting in teratogenic effects is 240 mg/kg. The adjusted ordering number based on teratogenicity is 12.9.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Benzo(a)pyrene appears on EPA Consent Decree List with an assigned priority of 1.

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/3{,}314{,}500 = 0.02$ μg/m^3

Water, Health: $15 \times 0.02 = 0.3$ μg/ℓ

Land, Health: $0.002 \times 0.3 = 0.006$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 50 = 5.35$ μg/m^3

$EPC_{AH3} = 0.081 \times 50 = 4.1$ μg/m^3

$EPC_{WH1} = 15 \times 4.1 = 61.5$ μg/ℓ

$EPC_{WH2} = 0.4 \times 50 = 20$ μg/ℓ

$EPC_{LH} = 0.002 \times 20 = 0.04$ μg/g

$EPC_{AC2} = 10^3/(6 \times 3{,}314{,}500) = 5 \times 10^{-5}$ μg/m^3

$EPC_{WC} = 15 \times 5 \times 10^{-5} = 7.5 \times 10^{-4}$ μg/ℓ

$EPC_{LC} = 0.002 \times 7.5 \times 10^{-4} = 1.5 \times 10^{-6}$ μg/g

$EPC_{AT} = 10^3/(6 \times 12.9) = 12.9$ μg/m^3

$EPC_{WT} = 15 \times 12.9 = 194$ μg/ℓ

$EPC_{LT} = 0.002 \times 194 = 0.39$ μg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.0E-2		5.0E-5		4E-5 to 4E-4†
Water, $\mu g/l$ (ppm Wt)			3.0E-1		7.5E-4		0.02‡
Land, $\mu g/g$ (ppm Wt)			6.0E-3		1.5E-6		0 to 0.13§

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			4.1		5×10^{-5}
Water, $\mu g/l$ (ppm Wt)			20		7.5×10^{-4}
Land, $\mu g/g$ (ppm Wt)			0.04		1.5 x 10-6

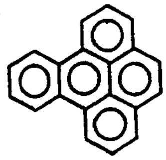
†Reported for urban atmosphere.
‡Drinking water.
§Sand, non-industrial areas.

CATEGORY: 21

BENZO(e)PYRENE: $C_{20}H_{12}$ (4,5-benzopyrene).
Prisms or plates from benzene.

WLN:

STRUCTURE:



PROPERTIES:

Molecular wt: 252; mp: 178-9; sublimes at 250° (4 mm); insoluble in water, solubility may be enhanced by surfactant impurities in water (ref. 58); lipid solubility: 2.5 percent in olive oil (ref. 72).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Benzo(e)pyrene is a constituent of the high-boiling coal tar (ref. 77). It has been isolated from soils (ref. 81). The lowest reported urban concentration for benzo(e)pyrene is 0.90 ng/m^3 (ref. 1).

Benzo(e)pyrene is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The following concentrations of carcinogenic PPAH have been estimated or reported: Air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); ground-water and surface-treated water: 0.001 μg/ℓ - 0.025 μg/ℓ (ref. 58): upper layer of earth's crust: 100 μg/kg - 1,000 μg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

Benzo(e)pyrene may be present in soot, coal tar, and pitch which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59).

Benzo(e)pyrene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3223. The lowest dose to induce an oncogenic response is reported as 140 mg/kg. The adjusted ordering number is 23.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/23 = 3.04 \times 10^3$ μg/m^3	Air, Ecology:
Water, Health: $15 \times 3.04 \times 10^3 = 4.56 \times 10^4$ μg/ℓ	Water, Ecology:
Land, Health: $0.002 \times 4.57 \times 10^4 = 91.2$ μg/g	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 23) = 7.25$ μg/m^3
$EPC_{WC} = 15 \times 7.25 = 109$ μg/ℓ
$EPC_{LC} = 0.002 \times 109 = 0.22$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.04E3		7.25		
Water, $\mu g/l$ (ppm Wt)			4.56E4		109		
Land, $\mu g/g$ (ppm Wt)			9.12E1		0.22		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

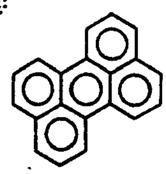
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					7.25
Water, $\mu g/l$ (ppm Wt)					109
Land, $\mu g/g$ (ppm Wt)					0.22

CATEGORY: 21

WLN: L666 L6 K6 2AL

PERYLENE: $C_{20}H_{12}$ (peri-dinaphthalene, dibenz(de,kl) anthracene). Yellow to colorless plates from toluene.

STRUCTURE:



PROPERTIES:

Molecular wt: 252.34; mp: 277-279; sublimes 350-400° C; d: 1.35; insoluble in water, solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Perylene occurs in coal tar and in high-boiling petroleum fractions. The lowest reported urban level for perylene is given as 0.10 ng/m^3 (ref. 1).

Perylene is associated with particulate polycyclic aromatic hydrocarbons PPAH (ref. 71). The following concentrations of carcinogenic PPAH have been estimated or reported: Air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); ground-water and surface-treated water: 0.001 μg/ℓ - 0.025 μg/ℓ (ref. 58): upper layer of earth's crust: 100 μg/kg - 1000 μg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

There is no report of oncogenic responses in animals or humans which are attributable to this compound.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health:
Water, Health:
Land, Health:

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)							0.0001†
Water, $\mu g/l$ (ppm Wt)							
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					
Water, $\mu g/l$ (ppm Wt)					
Land, $\mu g/g$ (ppm Wt)					

†Reported for urban atmosphere. No rural concentration is reported.

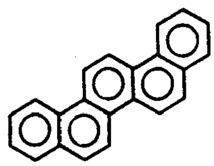
CATEGORY: 21

WLN: L F6 E6 B666J

PICENE: $C_{22}H_{14}$ (1,2-7,8-dibenzphenanthrene, dibenzo(a,i) phenanthrene).

Crystallizes in the form of plates with bluish fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt: 278.33; mp: 367; sublimes 300° C; bp: 518-20; insoluble in water, solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Picene is found in tar oils from soft coal and in petroleum.

The rural concentration for picene is reported as 0.0974 μg/1,500 m^3 (ref. 4). This is equivalent to 0.06 ng/m^3. Picene probably occurs as a constituent of particulate polycyclic aromatic hydrocarbons.

TOXIC PROPERTIES, HEALTH EFFECTS:

Picene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59).

Picene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3121. The lowest dose to induce an oncogenic response is reported as 111 mg/kg. The adjusted ordering number is 28.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/28 = 2.5 \times 10^3$ μg/m^3

Water, Health: $15 \times 2.5 \times 10^3 = 3.75 \times 10^4$ μg/ℓ

Land, Health: $0.002 \times 3.75 \times 10^4 = 75$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 28) = 5.95$ μg/m^3

$EPC_{WC} = 15 \times 5.95 = 89.3$ μg/ℓ

$EPC_{LC} = 0.002 \times 89.3 = 0.18$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.5E3		5.95		0.00006
Water, $\mu g/l$ (ppm Wt)			3.75E4		89.3		
Land, $\mu g/g$ (ppm Wt)			7.5E1		0.18		

*To be multiplied by dilution factor

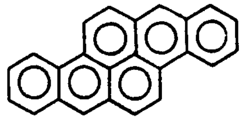
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					5.95
Water, $\mu g/l$ (ppm Wt)					89.3
Land, $\mu g/g$ (ppm Wt)					0.18

CATEGORY: 21

WLN: L D6 B66 D666 2AB A&J

DIBENZO(a,h)PYRENE: $C_{24}H_{14}$,(dibenzo(b,def) - chrysene, DB(a,h)P).

STRUCTURE:



Crystallizes as gold-orange plates from trichlorobenzene.

PROPERTIES:

Molecular wt: 302; mp: 315; insoluble in water, solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Dibenzo(a,h)pyrene is a constituent of coal-tar pitch. It may be formed by pyrolysis of anthracene. Dibenzo(a,h)pyrene is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The following concentrations of carcinogenic PPAH have been estimated or reported: Air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); ground-water and surface-treated water: 0.001 μg/ℓ - 0.025 μg/ℓ (ref. 58); upper layer of Earth's crust: 100 μg/kg - 1,000 μg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

Dibenzo(a,h)pyrene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59).

Dibenzo(a,h)pyrene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3121. The lowest dose to induce a carcinogenic response is reported as 165 mg/kg. The adjusted ordering number is 18.9.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 [for particulate polycyclic aromatic hydrocarbons (PPAH). This TLV recognizes the carcinogenic potential of PPAH collectively].

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/18.9 = 3.7 \times 10^3$ μg/m^3

Water, Health: $15 \times 3.7 \times 10^3 = 5.55 \times 10^4$ μg/ℓ

Land, Health: $0.002 \times 5.55 \times 10^4 = 111$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 18.9) = 8.8$ μg/m^3

$EPC_{WC} = 15 \times 8.8 = 132$ μg/ℓ

$EPC_{LC} = 0.002 \times 132 = 0.26$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.7E3		8.8		
Water, $\mu g/l$ (ppm Wt)			5.55E4		132		
Land, $\mu g/g$ (ppm Wt)			1.1E2		0.26		

*To be multiplied by dilution factor

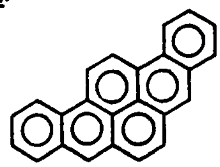
AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					8.8
Water, $\mu g/l$ (ppm Wt)					132
Land, $\mu g/g$ (ppm Wt)					0.26

CATEGORY: 21

WLN: L D6 B66 P666 2AB A+J

STRUCTURE:



DIBENZO(a,i)PYRENE: $C_{24}H_{14}$ (benzo(rst)pentaphene).
Crystallizes as greenish-yellow needles or plates, benzene solutions exhibit blue fluorescence.

PROPERTIES:

Molecular wt: 302; mp: 281.5; insoluble in water, solubility may be enhanced by surfactant impurities in water (ref. 58); lipid solubility: 2.5 mg in 0.2 ml tri-octanoin (ref. 72).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Dibenzo(a,i)pyrene is present in coal tar (ref. 73).

Dibenzo(a,i)pyrene is associated with particulate polycyclic aromatic hydrocarbons, PPAH, (ref. 72). The following concentrations of carcinogenic PPAH have been estimated or reported: Air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); ground-water and surface-treated water: 0.001 µg/ℓ - 0.025 µg/ℓ (ref. 58): upper layer of Earth's crust: 100 µg/kg - 1,000 µg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

Dibenzo(a,i)pyrene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59).

Dibenzo(a,i)pyrene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3225. The lowest dose to induce a carcinogenic response is reported as 2 mg/kg. The adjusted ordering number is 1612.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 [for particulate polycyclic aromatic hydrocarbons (PPAH). This TLV recognizes the carcinogenic potential of PPAH collectively].

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/1,612 = 43.4$ µg/m^3
Water, Health: $15 \times 43.4 = 651$ µg/ℓ
Land, Health: $0.002 \times 651 = 1.3$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 1,612) = 0.1$ µg/m^3
$EPC_{WC} = 15 \times 0.1 = 1.5$ µg/ℓ
$EPC_{LC} = 0.002 \times 1.5 = 0.003$ µg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.3E1		0.1		
Water, $\mu g/l$ (ppm Wt)			6.5E2		1.5		
Land, $\mu g/g$ (ppm Wt)			1.3E0		0.003		

*To be multiplied by dilution factor

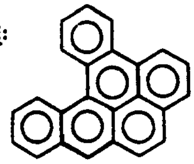
AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					0.1
Water, $\mu g/l$ (ppm Wt)					1.5
Land, $\mu g/g$ (ppm Wt)					0.003

CATEGORY: 21

WLN: L D66 K666 B6 2AB A&J

STRUCTURE:



DIBENZO(a,l)PYRENE: $C_{24}H_{14}$ (dibenzo(def,p)chrysene, 1,2-9,10-dibenzopyrene).
Colorless prisms from cyclohexane.

PROPERTIES:

Molecular wt: 302.24; mp: 164; insoluble in water, solubility may be enhanced by surfactant impurities in water (ref. 58); lipid solubility: 0.6 mg/0.2 ml olive oil (ref. 72).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Dibenzo(a,l)pyrene is probably not a naturally occurring isomer. Its synthesis has been reported (ref. 73). Investigations previous to 1966 concerning dibenzo(a,l)pyrene were probably carried out with dibenzo(a,e)fluoranthene (ref. 73). If the compound occurs in the atmosphere, it will probably be associated with particulate polycyclic aromatic hydrocarbons, PPAH.

TOXIC PROPERTIES, HEALTH EFFECTS:

Dibenzo(a,l)pyrene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3101. The lowest dose to induce a carcinogenic response is reported as 48 mg/kg. The adjusted ordering number is 64.6.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/64.6 = 1.08 \times 10^3$ µg/m^3
Water, Health: $15 \times 1.08 \times 10^3 = 1.6 \times 10^4$ µg/ℓ
Land, Health: $0.002 \times 1.6 \times 10^4 = 32$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 64.6) = 2.6$ µg/m^3
$EPC_{WC} = 15 \times 2.6 = 39$ µg/ℓ
$EPC_{LC} = 0.002 \times 39 = 0.078$ µg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.08E3		2.6		
Water, $\mu g/l$ (ppm Wt)			1.6E4		39		
Land, $\mu g/g$ (ppm Wt)			3.2E1		0.08		

*To be multiplied by dilution factor

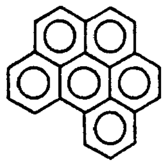
AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					2.6
Water, $\mu g/l$ (ppm Wt)					39
Land, $\mu g/g$ (ppm Wt)					0.08

CATEGORY: 21

WLN: L666 B6 C6 D6 4ABCD VJ

STRUCTURE:



BENZO(ghi)PERYLENE: $C_{22}H_{12}$ (1,12-Benzoperylene).
Leaflets from benzene; exhibits bright green-yellow fluorescence.

PROPERTIES:

Molecular wt: 276; mp: 222-3; insoluble in water;
solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Benzo(ghi)perylene occurs in tar and in smoke-polluted atmospheres. The urban concentration for benzo-(ghi)perylene is reported as 3.27 ng/m^3 (ref. 1).

Benzo(ghi)perylene is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The following concentrations of carcinogenic PPAH have been estimated or reported: Air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); ground-water and surface-treated water: 0.001 μg/ℓ - 0.025 μg/ℓ (ref. 58): upper layer of earth's crust: 100 μg/kg - 1,000 μg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

Benzo(ghi)perylene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Topical application of benzo(ghi)perylene in acetone solution (mixture with phenanthrene, anthracene, pyrene, fluoranthene, chrysene, 3,4- and 1,2-benzopyrene, 1,2,5,6-dibenzanthracene, and 1,2-benzanthracene) induced four tumors in 225 mice (ref. 60). Data pertinent to the carcinogenic potential of benzo(ghi)perylene alone are currently not available. The compound is probably not a highly active carcinogen.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Benzo(ghi)perylene appears on EPA Consent Decree List with an assigned priority of 1.

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health:
Water, Health:
Land, Health:

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)							0.003†
Water, $\mu g/l$ (ppm Wt)							
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					
Water, $\mu g/l$ (ppm Wt)					
Land, $\mu g/g$ (ppm Wt)					

†Value is for urban atmosphere. No rural concentration is reported.

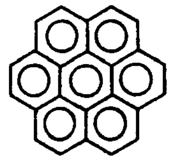
CATEGORY: 21

WLN: L666 B6 C6 D6 E6 6ABCDEF A&J

CORONENE: $C_{24}H_{12}$ (hexabenzobenzene).

Yellow needles from benzene; solutions exhibit bluish-violet fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt: 300.36; mp: 438; bp: 525; d: 1.377; insoluble in water, solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Urban concentrations of coronene are reported ranging 1.252 ng/1,500 m^3 to 2.13 ng/m^3 (ref. 1).

Coronene is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The following concentrations of carcinogenic PPAH have been estimated or reported: Air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); ground-water and surface-treated water: 0.001 µg/ℓ - 0.025 µg/ℓ (ref. 58): upper layer of earth's crust: 100 µg/kg - 1,000 µg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

Coronene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Topical application of coronene in acetone solution (mixture with phenanthrene, anthracene, pyrene, fluoranthene, chrysene, 3,4- and 1,2-benzopyrene, 1,12-benzperylene, anthanthrene, 1,2,5,6-dibenzanthracene, and 1,2-benzanthracene) induced four tumors in 225 mice (ref. 60). Data pertinent to the carcinogenic potential of coronene alone are currently unavailable.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health:	Air, Ecology:
Water, Health:	Water, Ecology:
Land, Health:	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)							0.002†
Water, $\mu g/l$ (ppm Wt)							
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					
Water, $\mu g/l$ (ppm Wt)					
Land, $\mu g/g$ (ppm Wt)					

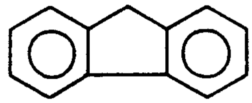
†Reported for urban atmosphere. No rural concentration is reported.

CATEGORY: 22

WLN:

FLUORENE: $C_{13}H_{10}$ (2,3-benzindene, diphenylenemethane). Fluorescent, colorless flakes.

STRUCTURE:



PROPERTIES:

Molecular wt: 166.15; mp: 116-117; bp: 293-295; d: 1.203^{0}; vap. p: 10 mm at 146.0°C; insoluble in water, solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Fluorene is among the lower molecular weight polycyclic hydrocarbons comprising the volatile portion of the benzene soluble fraction of coal tar (ref. 4). Fluorene is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The following concentrations of PPAH have been estimated or reported: Air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); groundwater and surface-treated water: 0.001 μg/ℓ - 0.025 μg/ℓ (ref. 58): upper layer of earth's crust: 100 μg/kg - 1,000 μg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

Fluorene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Carcinogenic polycyclic aromatic hydrocarbons may induce tumors at the site of application (ref. 59). There is currently no evidence to indicate that fluorene alone is carcinogenic.

Subcutaneous injection of fluorene in a 1:1 molar ratio to benzo(a)pyrene showed no inhibitory effect on the carcinogenicity of B(a)P (ref. 72).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Fluorene appears on EPA Consent Decree List with an assigned priority of 1.

TLV (coal tar pitch volatiles): 0.2 mg/m^3.

[The specification includes naphthalene, anthracene, acridine, phenanthrene, and fluorene, collectively. The purpose of the TLV is to minimize concentrations of higher weight polycyclic hydrocarbons which are carcinogenic (ref. 4).]

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health:
Water, Health:
Land, Health:

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)							
Water, $\mu g/l$ (ppm Wt)							
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

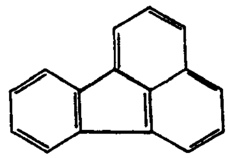
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					
Water, $\mu g/l$ (ppm Wt)					
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 22

WLN: L C6566 1A PJ

FLUORANTHENE: $C_{16}H_{10}$ (benzo(j,k)fluorene).
Colorless needles or plates from alcohol.

STRUCTURE:



PROPERTIES:

Molecular wt: 202.26; mp: 110; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Fluoranthene is present in coal tar (ref. 77) and is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The following concentrations of PPAH have been estimated or reported: Air (urban environment in winter in seven selected U.S. cities): 21.6 ng/m^3 - 146 ng/m^3 (ref. 71); groundwater and surface-treated water: 0.001 μg/ℓ - 0.025 μg/ℓ (ref. 58): upper layer of earth's crust: 100 μg/kg - 1,000 μg/kg (ref. 58).

TOXIC PROPERTIES, HEALTH EFFECTS:

LD_{50} (oral, rat): 2,000 mg/kg

Fluoranthene may be present in soot, coal tar, and pitch which are known to be carcinogenic to man. Topical application of fluoranthene in acetone (mixture with phenanthrene, anthracene, pyrene, chrysene, B(a)P, B(e)P, perylene, anthanthrene, DB(a,j)A, and BA) induced four tumors in 225 mice (ref. 60). There is currently no evidence to indicate that fluoranthene alone is carcinogenic.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

Fluoranthene appears on the EPA Consent Decree List with an assigned priority of 2.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 2{,}000 = 9.0 \times 10^4$ μg/m^3
Water, Health: $15 \times 9 \times 10^4 = 1.4 \times 10^6$ μg/ℓ
Land, Health: $0.002 \times 1.4 \times 10^6 = 2.8 \times 10^3$ μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 2{,}000 = 214$ μg/m^3
$EPC_{AH3} = 0.081 \times 2{,}000 = 162$ μg/m^3
$EPC_{WH1} = 15 \times 162 = 2{,}430$ μg/ℓ
$EPC_{WH2} = 0.4 \times 2{,}000 = 800$ μg/ℓ
$EPC_{LH} = 0.002 \times 800 = 1.6$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			9.0E4		162		
Water, $\mu g/l$ (ppm Wt)			1.4E6		800		
Land, $\mu g/g$ (ppm Wt)			2.8E3		1.6		

*To be multiplied by dilution factor

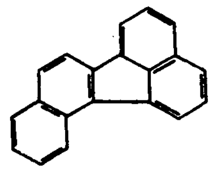
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			162		
Water, $\mu g/l$ (ppm Wt)			800		
Land, $\mu g/g$ (ppm Wt)			1.6		

CATEGORY: 22

WLN: L D6 C6566 1A TJ

BENZO(j)FLUORANTHENE: $C_{20}H_{12}$ (10,11-benzo-fluoranthene, B(j)F).
Yellow plates or needles from alcohol.

STRUCTURE:



PROPERTIES:

Molecular wt: 252.32; mp: 165; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Benzo(j)fluoranthene may be obtained from coal tar and from the high-temperature pyrolysis of anthracene, naphthalene, tobacco constituents, and other organic compounds (ref. 73). A concentration of B(j)F in urban atmosphere is reported as 1.3 ng/m^3 (ref. 1). Benzo(j)fluoranthene is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). Other environmental concentrations of B(j)F (with B(b)F) are reported as follows: soil--15 to 110 μg/kg; drinking water--1 to 14.0 μg/m^3 (ref. 73). It has also been detected in oils of certain fruits and in cooked foods (ref. 73).

TOXIC PROPERTIES, HEALTH EFFECTS:

Benzo(j)fluoranthene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Benzo(j)fluoranthene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3121. The lowest dose to induce a carcinogenic response is reported as 288 mg/kg. The adjusted ordering number is 10.8.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/10.8 = 6.5 \times 10^3$ μg/m^3
Water, Health: $15 \times 6.5 \times 10^3 = 9.8 \times 10^4$ μg/ℓ
Land, Health: $0.002 \times 9.8 \times 10^4 = 200$ μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 10.8) = 15.4$ μg/m^3
$EPC_{WC} = 15 \times 15.4 = 231$ μg/ℓ
$EPC_{LC} = 0.002 \times 231 = 0.5$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			6.5E3		15.4		0.001†
Water, $\mu g/l$ (ppm Wt)			9.8E4		231		
Land, $\mu g/g$ (ppm Wt)			2.0E2		0.5		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					15.4
Water, $\mu g/l$ (ppm Wt)					231
Land, $\mu g/g$ (ppm Wt)					0.5

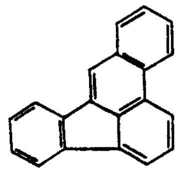
†Reported for urban atmosphere. No rural concentration is reported.

CATEGORY: 22

WLN: L C65 K666 1A

BENZO(b)FLUORANTHENE: $C_{20}H_{12}$ (benz(e)acephenantrylene, 2,3-benzofluoranthene, B(b)F).
Needles from benzene.

STRUCTURE:



PROPERTIES:

Molecular wt: 252; mp: 167; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58); lipid solubility: 0.6 mg/2 ml olive oil (ref. 72).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Benzo(b)fluoranthene is formed by the high-temperature pyrolysis of anthracene, some tobacco constituents, and other organic compounds (ref. 73). Benzo(b)fluoranthene is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). Concentrations of benzo(b)fluoranthene measured in urban atmosphere range from 0.54 ng/m^3 to 22 ng/m^3 (ref. 1). Other environmental concentrations of B(b)F with B(j)F are reported as follows: drinking water--0.8 to 11.5 μg/m^3; soils (nonindustrial)--15 to 110 μg/kg (ref. 73). It has also been detected in foods, leaves of various trees, and algae (ref. 73).

TOXIC PROPERTIES, HEALTH EFFECTS:

Benzo(b)fluoranthene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Benzo(b)fluoranthene appears in NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3122. The lowest dose to induce a carcinogenic response is reported as 40 mg/kg. The adjusted ordering number is 78.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Benzo(b)fluoranthene appears on EPA Consent Decree List with an assigned priority of 1.

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/78 = 900$ μg/m^3	Air, Ecology:
Water, Health: $15 \times 900 = 1.34 \times 10^4$ μg/ℓ	Water, Ecology:
Land, Health: $0.002 \times 1.34 \times 10^4 = 26.9$ μg/g	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 78) = 2.1$ μg/m^3

$EPC_{WC} = 15 \times 2.1 = 31.5$ μg/ℓ

$EPC_{LC} = 0.002 \times 31.5 = 0.06$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			9.0E2		2.1		0.0005-0.02†
Water, $\mu g/l$ (ppm Wt)			1.34E4		31.5		
Land, $\mu g/g$ (ppm Wt)			2.7E1		0.06		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					2.1
Water, $\mu g/l$ (ppm Wt)					31.5
Land, $\mu g/g$ (ppm Wt)					0.06

†Reported for urban atmosphere. No rural concentration is reported.

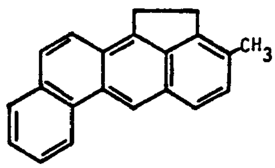
CATEGORY: 22

WLN: L E6 D6656 1A T&&&T&J R

3-METHYLCHOLANTHRENE: $C_{21}H_{16}$ (benz(j)aceanthrylene-1,2-dihydro-3-methyl, 20-methylcholanthrene)

Straw-yellow needles from benzene.

STRUCTURE:



PROPERTIES:
Molecular wt: 268.37; mp: 176.5-177.5; d: 1.28^{20}; insoluble in water; solubility may be enhanced by surfactant impurities in water (ref. 58); lipid solubility: 12 mg/ml in tributyrin (ref. 74).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

3-Methylcholanthrene may be formed by the pyrolytic degradation of cholesterol derivatives (ref. 24). The compound may occur as a constituent of particulate polycyclic aromatic hydrocarbons, PPAH.

TOXIC PROPERTIES, HEALTH EFFECTS:

3-Methylcholanthrene is a known carcinogen. It causes chromosome abberations in mammalian cells (ref. 42). The compound is included in the NIOSH Suspected Carcinogens List. The ordering number is 5829. The lowest dose to induce a response is reported as 0.312 mg/kg. The adjusted ordering number is 18,683.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/18{,}683 = 3.75\ \mu g/m^3$

Water, Health: $15 \times 3.75 = 56\ \mu g/\ell$

Land, Health: $0.002 \times 56 = 0.112\ \mu g/g$

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 18{,}683) = 0.009\ \mu g/m^3$

$EPC_{WC} = 15 \times 0.009 = 0.14\ \mu g/\ell$

$EPC_{LC} = 0.002 \times 0.14 = 2.8 \times 10^{-4}\ \mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.8E0		0.009		
Water, $\mu g/l$ (ppm Wt)			5.6E1		0.14		
Land, $\mu g/g$ (ppm Wt)			1.1E-1		3×10^{-4}		

*To be multiplied by dilution factor

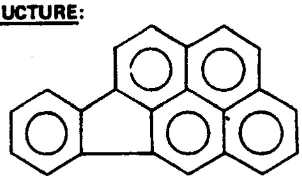
AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					0.009
Water, $\mu g/l$ (ppm Wt)					0.14
Land, $\mu g/g$ (ppm Wt)					3×10^{-4}

CATEGORY: 22

WLN: L E6 C5666 B6 3ABC BJ

STRUCTURE:



INDENO(1,2,3-cd)PYRENE: $C_{22}H_{12}$ (2,3-O-phenylenepyrene, IP). Yellow plates or needles from light petroleum, greenish fluorescence.

PROPERTIES:

Molecular wt: 276.34; mp: 162.5-164; insoluble in water; solubility may be enhanced by surfactant impurities in water; lipid solubility: 0.6 mg/2 ml olive oil (ref. 72).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Indeno(1,2,3-cd)pyrene is present in coal tar. It is formed by high-temperature pyrolysis of tobacco constituents (ref. 73). Indeno(1,2,3-cd)pyrene is associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). Environmental concentrations of indeno(1,2,3-cd)pyrene are reported as follows: air dust--0.96 mg/kg; soils (forest)--0.6 mg/kg; drinking water--0.1 to 12.6 $\mu g/m^3$ (ref. 73). It has also been detected in oils from certain fruits, leaves of various kinds of trees, and in algae (ref. 73).

TOXIC PROPERTIES, HEALTH EFFECTS:

Indeno(1,2,3-cd)pyrene may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man. Indeno(1,2,3-cd)pyrene is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3101. The lowest dose to induce a carcinogenic response is reported as 72 mg/kg. The adjusted ordering number is 43.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Indeno(1,2,3-cd)pyrene appears on EPA Consent Decree List with an assigned priority of 1.

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/43 = 1.63 \times 10^3$ $\mu g/m^3$

Water, Health: $15 \times 1.63 \times 10^3 = 2.4 \times 10^4$ $\mu g/\ell$

Land, Health: $0.002 \times 2.4 \times 10^4 = 48$

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 43) = 3.9$ $\mu g/m^3$

$EPC_{WC} = 15 \times 3.9 = 58.5$ $\mu g/\ell$

$EPC_{LC} = 0.002 \times 58.5 = 0.1$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.63E3		3.9		
Water, $\mu g/l$ (ppm Wt)			2.4E4		58.5		0.0001-0.01†
Land, $\mu g/g$ (ppm Wt)			4.8E1		0.1		0.6

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					3.9
Water, $\mu g/l$ (ppm Wt)					58.5
Land, $\mu g/g$ (ppm Wt)					0.1

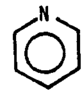
† Drinking water.

CATEGORY: 23A

WLN: T6NJ

PYRIDINE: C_5H_5N (azabenzene, azine).
Colorless liquid; sharp, penetrating odor, burning taste.

STRUCTURE:



PROPERTIES:

Molecular wt: 79.10; mp: -42; bp: 115.5; d: 0.9819^{20};
vap. press: 10 mm at 13.2° C; vap. d: 2.73; pK_a: 5.23 (ref. 82); soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Pyridine and its methyl derivatives are usually obtained from the degradation of coal. As a typical heterocyclic aromatic compound, pyridine undergoes both nucleophilic and electrophilic substitutions. Pyridine is photolytically active (ref. 83). The basicity of pyridine is less than that of aromatic amines (ref. 84).

The odor threshold for pyridine is reported as 0.021 ppm or approximately 68 $\mu g/m^3$ (ref. 29). The rural concentration of pyridine is reported as 21 ppb (ref. 1). This is equivalent to 67.7 $\mu g/m^3$. (This level is probably high since it is representative of an agricultural area.)

TOXIC PROPERTIES, HEALTH EFFECTS:

Pyridine is mildly irritating to the skin and causes depression of the central nervous system. Mild symptoms are reported from exposure to 10 ppm. Chronic poisoning may result in damage to liver, kidney, and bone marrow (ref 4).

LD_{50} (oral, rat): 891 mg/kg.

LC_{50} (inhalation, rat): 4,000 ppm for 4 hr.

Toxicity to aquatic life: The 96-hr TLm is reported ranging from 1,000 to 100 ppm (ref. 2).

Pyridine in water in concentrations as low as 5 mg/ℓ may cause tainting of fish flesh (refs. 69, 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 15 mg/m^3 (5 ppm). (The TLV is sufficient to prevent acute or chronic poisoning but is substantially higher than the odor threshold.)

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.50×10^4 $\mu g/m^3$ (5 ppm)
Water, Health: $15 \times 1.50 \times 10^4 = 2.25 \times 10^5$ $\mu g/\ell$
Land, Health: $0.002 \times 2.25 \times 10^5 = 450$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ $\mu g/\ell$
Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 15/420 = 35.7$ $\mu g/m^3$
$EPC_{AH1a} = 5/420 = 0.012$ ppm
$EPC_{WH1} = 15 \times 35.7 = 535.5$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 15 = 207$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 207 = 0.414$ $\mu g/g$

$EPC_{WE1} = 50 \times 100 = 5{,}000$ $\mu g/\ell$
$EPC_{WE2} = 5{,}000$ $\mu g/\ell$ (to prevent tainting)
$EPC_{LE} = 0.002 \times 5{,}000 = 10$ $\mu g/g$

MULTIMEDIA ENVIRONMENTAL GOALS

X
23A
PYRIDINE

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.50E4 (5)		35.7 (0.012)		
Water, $\mu g/l$ (ppm Wt)			2.25E5	1.0E4	207	5,000	
Land, $\mu g/g$ (ppm Wt)			4.5E2	2.0E1	0.414	10	

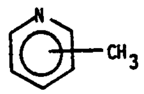
*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			35.7 (0.012)		
Water, $\mu g/l$ (ppm Wt)			207	5,000	
Land, $\mu g/g$ (ppm Wt)			0.414	10	

CATEGORY: 23A

WLN:

STRUCTURE:



PICOLINES: C_6H_7N (2-methylpyridine, 3-methylpyridine, 4-methylpyridine).

The picolines have a strong, unpleasant odor.

PROPERTIES:

Molecular wt: 93.14; bp: 129-145; d: 0.95 to 0.97_4^{15}; pK_a: 5.68-5.96 (ref. 82); soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Pyridine, picolines, and lutidines are usually obtained by the degradation of coal. They display aromaticity in their substitution reactions. As bases they are less basic than aliphatic amines (ref. 84). Pyridine and pyridine-ring compounds are photolytically active (ref. 83).

TOXIC PROPERTIES, HEALTH EFFECTS:

The picolines are irritating to the eyes and to the respiratory tract (ref. 41).

	LD_{50} (oral, rat) (ref. 2)	LD_{100} (inhalation, rat) (ref. 41)
2-picoline	790 mg/kg	15,400 ppm/1.5 hr
3-picoline	800 mg/kg	8,700 ppm/2.2 hr
4-picoline	800 mg/kg	8,000 ppm/2 hr

Certain pyridine compounds are reported to cause tainting of fish (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 790 = 3.56 \times 10^4$ μg/m³

Water, Health: $15 \times 3.56 \times 10^4 = 5.34 \times 10^5$ μg/ℓ

Land, Health: $0.002 \times 5.33 \times 10^5 = 1.07 \times 10^3$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 790 = 84.5$ μg/m³

$EPC_{AH3} = 0.081 \times 790 = 64.0$ μg/m³

$EPC_{WH} = 15 \times 64 = 960$ μg/ℓ

$EPC_{WH2} = 0.4 \times 790 = 316$ μg/ℓ

$EPC_{LH} = 0.002 \times 316 = 0.63$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.56E4		64		
Water, $\mu g/l$ (ppm Wt)			5.34E5		316		
Land, $\mu g/g$ (ppm Wt)			1.07E3		0.6		

*To be multiplied by dilution factor

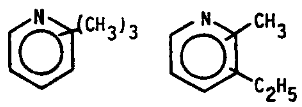
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			64.0		
Water, $\mu g/l$ (ppm Wt)			316		
Land, $\mu g/g$ (ppm Wt)			0.6		

CATEGORY: 23A

WLN:

COLLIDINES: $C_8H_{11}N$ (trimethylpyridines, ethyl methyl pyridines).

STRUCTURE:



PROPERTIES:

Molecular wt: 121; bp: 165-198; d: 0.9130-0.9352; pK_a: 7.1-7.45 (ref. 82); sparingly soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Collidines are found in low temperature tar. In general, they exhibit characteristics of aromatic compounds. As bases they are stronger than pyridine.

Pyridine and its derivatives are photolytically active (ref. 83).

TOXIC PROPERTIES, HEALTH EFFECTS:

The simple alkyl derivatives of pyridine act as local irritants (ref. 41). 2-Methyl-5-ethyl-pyridine is listed as a corrosive liquid (ref. 2).

LD_{50} (oral, rat): 1,540 mg/kg for 5-ethyl-2-methylpyridine.

Aquatic toxicity: The 96-hr TLm for 2-methyl-5-ethyl-pyridine is reported as 100 to 1,000 ppm (ref. 2). Certain pyridine compounds cause tainting of fish flesh (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 1{,}540 = 6.93 \times 10^4$ µg/m³

Water, Health: $15 \times 6.93 \times 10^4 = 1.04 \times 10^6$ µg/ℓ

Land, Health: $0.002 \times 1.04 \times 10^6 = 2.08 \times 10^3$ µg/g

Air, Ecology:

Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ µg/ℓ

Land, Ecology: $0.002 \times 1.0 \times 10^4 = 20$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 1{,}540 = 165$ µg/m³

$EPC_{AH3} = 0.081 \times 1{,}540 = 125$ µg/m³

$EPC_{WH1} = 15 \times 125 = 1{,}875$ µg/ℓ

$EPC_{WH2} = 0.4 \times 1{,}540 = 616$ µg/ℓ

$EPC_{LH} = 0.002 \times 616 = 1.23$ µg/g

$EPC_{WE1} = 50 \times 100 = 5{,}000$ µg/ℓ

$EPC_{LE} = 0.002 \times 5{,}000 = 10$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			6.93E4		125		
Water, $\mu g/l$ (ppm Wt)			1.04E6	1.0E4	616	5,000	
Land, $\mu g/g$ (ppm Wt)			2.08E3	2.0E1	1.23	10	

*To be multiplied by dilution factor

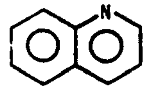
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			125		
Water, $\mu g/l$ (ppm Wt)			616	5,000	
Land, $\mu g/g$ (ppm Wt)			1.23	10	

CATEGORY: 23B

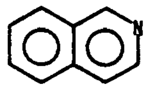
WLN: T66 BNJ
T66 CNJ

STRUCTURE:

Quinoline



Isoquinoline



QUINOLINE: C_9H_7N (1-benzazine, chinoline, benzo(b)pyridine).
ISOQUINOLINE: (leucoline, benzo(c)pyridine).
Liquids with strong odors.

PROPERTIES:

Quinoline: Molecular wt: 129.1; mp: -15; bp: 237.7; d: 1.09_4^{25}; vap. press: 1 mm at 59.7° C; soluble in hot water.

Isoquinoline: Molecular wt: 129.1; mp: 26.48; d: 1.091_4^{30}; slightly soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Quinoline and isoquinoline are isolated in small amounts from coal tar. They are less basic than aliphatic amines. Compounds containing the pyridine ring are photolytically active (ref. 83).

TOXIC PROPERTIES, HEALTH EFFECTS:

Toxicity information for quinoline is very sparse. It is a mild irritant.
LD_{50} (oral, rat): 460 mg/kg for quinoline.
LD_{50} (oral, rat): 350 mg/kg for isoquinoline.
Concentrations of 0.5 to 1.0 mg/ℓ in water may cause tainting of fish flesh (ref. 28, 69).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 350 = 1.58 \times 10^4$ μg/m³
Water, Health: $15 \times 1.58 \times 10^4 = 2.36 \times 10^5$ μg/ℓ
Land, Health: $0.002 \times 2.36 \times 10^5 = 473$ μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 350 = 37.5$ μg/m³
$EPC_{AH3} = 0.081 \times 350 = 28.4$ μg/m³
$EPC_{WH1} = 15 \times 28.4 = 426$ μg/ℓ
$EPC_{WH2} = 0.4 \times 350 = 140$ μg/ℓ
$EPC_{LH} = 0.002 \times 140 = 0.28$ μg/g

$EPC_{WE1} = 500$ (to prevent tainting)

$EPC_{LE} = 0.002 \times 500 = 1$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.58E4		28.4		
Water, $\mu g/l$ (ppm Wt)			2.36E5		140	500	
Land, $\mu g/g$ (ppm Wt)			4.7E2		0.28	1	

*To be multiplied by dilution factor

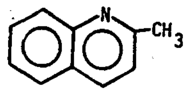
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			28.4		
Water, $\mu g/l$ (ppm Wt)			140	500	
Land, $\mu g/g$ (ppm Wt)			0.28	1	

CATEGORY: 23B

WLN: T66 BNJ C

2-METHYLQUINOLINE: $C_{11}H_9N$ (quinaldine).
Colorless, oily liquid with quinoline-like odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 143.2; bp: 246-247; d: 1.06;
insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

2-methylquinoline occurs in small amounts in coal tar. In general, it exhibits properties of aromatic compounds. Compounds containing the pyridine ring are photolytically active (ref. 83).

TOXIC PROPERTIES, HEALTH EFFECTS:

2-methylquinoline is a respiratory tract irritant (ref. 9).
LD_{50} (oral, rat): 1,230 mg/kg.
Certain quinoline compounds are reported to cause tainting of fish (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 1{,}230 = 5.54 \times 10^4$ µg/m³
Water, Health: $15 \times 5.54 \times 10^4 = 8.31 \times 10^5$ µg/ℓ
Land, Health: $0.002 \times 8.31 \times 10^5 = 1.66 \times 10^3$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 1{,}230 = 132$ µg/m³
$EPC_{AH3} = 0.081 \times 1{,}230 = 100$ µg/m³
$EPC_{WH1} = 15 \times 100 = 1{,}500$ µg/ℓ
$EPC_{WH2} = 0.4 \times 1{,}230 = 492$ µg/ℓ
$EPC_{LH} = 0.002 \times 492 = 0.98$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.54E4		100		
Water, $\mu g/l$ (ppm Wt)			8.31E5		492		
Land, $\mu g/g$ (ppm Wt)			1.66E3		0.98		

*To be multiplied by dilution factor

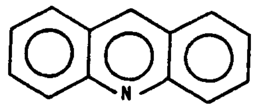
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			100		
Water, $\mu g/l$ (ppm Wt)			492		
Land, $\mu g/g$ (ppm Wt)			0.98		

CATEGORY: 23B

WLN: T C666 BNJ

ACRIDINE: $C_{13}H_9N$ (10-azaanthracene, benzo(b)quinoline, dibenzo(b,e)pyridine).
Small colorless crystals, dilute solutions exhibit violet fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt: 179.21; mp: 111; sublimes; bp: 345-346; pK_a: 5.6 (ref. 85) d: $1,005^{20}$; vap. press.: 1 mm at 129.4°; slightly soluble in hot water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Acridines may be found in coal tar and pitch. They are associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The concentration of acridine in urban atmosphere is reported as 0.67 µg/1,500 m^3 (ref. 1). This is equivalent to 0.00045 µg/m^3.

The acridines are classified as weak bases.

TOXIC PROPERTIES, HEALTH EFFECTS:

Acridine is irritating to skin and to mucous membranes (ref. 85). Acridine may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man (85, 73). There is no evidence to indicate that acridine alone is carcinogenic to man or to animals.

LD_{50} (oral, rat): 2,000 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (coal tar pitch volatiles): 0.2 mg/m^3. [The specification includes naphthalene, anthracene, acridine, phenanthrene, and fluorene, collectively. The purpose of the TLV is to minimize concentrations of higher-weight polycyclic hydrocarbons which are carcinogenic (ref. 4).]

A candidate for the list for EPA Toxic Pollutant Effluent Standards (ref. 10).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 2,000 = 9.0 \times 10^4$ µg/m^3

Water, Health: $15 \times 9.0 \times 10^4 = 1.35 \times 10^6$ µg/ℓ

Land, Health: $0.002 \times 1.35 \times 10^6 = 2.70 \times 10^3$ µg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 2,000 = 214$ µg/m^3

$EPC_{AH3} = 0.081 \times 2,000 = 162$ µg/m^3

$EPC_{WH1} = 15 \times 162 = 2,430$ µg/ℓ

$EPC_{WH2} = 0.4 \times 2,000 = 800$ µg/ℓ

$EPC_{LH} = 0.002 \times 800 = 1.6$ µg/ℓ

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			9.0E4		162		0.00045†
Water, $\mu g/l$ (ppm Wt)			1.35E6		800		
Land, $\mu g/g$ (ppm Wt)			2.70E3		1.6		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			162		
Water, $\mu g/l$ (ppm Wt)			800		
Land, $\mu g/g$ (ppm Wt)			1.6		

†Reported for urban atmosphere. No rural concentration is reported.

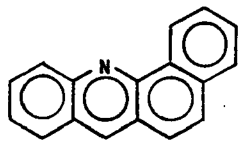
CATEGORY: 23B

WLN: T D6 B666 CNJ

BENZ(c)ACRIDINE: $C_{17}H_{11}N$ (α-chrysidine, α-naphthacridine)

Benz(c)acridine crystallizes in the form of needles from aqueous ethanol; solutions show green fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt: 229.29; mp: 108; pK_a: 3.24 (ref. 59); solubility in water may be enhanced by the presence of acids as impurities in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Acridines may be found in coal-tar and pitch. They are associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The concentration of benz(c) acridine in air polluted with coal tar pitch is reported as 0.12 μg/1,000 m^3; and the average urban atmospheric concentration in the U.S. is reported as 0.6 μg/1,000 m^3 (ref. 73).

The acridines are classified as weak bases.

TOXIC PROPERTIES, HEALTH EFFECTS:

Benz(c)acridine may be present in soot, coal tar, and pitch which are known to be carcinogenic to man (refs. 85, 73). Although it appears in the NIOSH Suspected Carcinogens List, benz(c)acridine is not considered to be a highly active carcinogen. The EPA/NIOSH ordering number is 3121. The lowest dose to induce a carcinogenic response is reported as 468 mg/kg. The adjusted ordering number is 6.66.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 [for particulate polycyclic aromatic hydrocarbons (PPAH). This TLV recognizes the carcinogenic potential of PPAH collectively].

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/6.66 = 1.05 \times 10^4$ μg/m^3

Water, Health: $15 \times 1.05 \times 10^4 = 1.58 \times 10^5$ μg/ℓ

Land, Health: $0.002 \times 1.58 \times 10^5 = 316$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

EPC_{AC2}

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 6.66) = 25.0$ μg/m^3

$EPC_{WC} = 15 \times 25 = 375$ μg/ℓ

$EPC_{LC} = 0.002 \times 375 = 0.75$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.05E4		25		0.0006†
Water, $\mu g/l$ (ppm Wt)			1.58E5		375		
Land, $\mu g/g$ (ppm Wt)			3.16E2		0.75		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					25
Water, $\mu g/l$ (ppm Wt)					375
Land, $\mu g/g$ (ppm Wt)					0.75

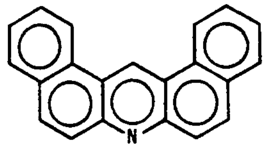
†Average for urban atmosphere. No rural concentration is reported.

CATEGORY: 23B

WLN: T E6 D6 B666 NNJ

DIBENZ(a,j)ACRIDINE: $C_{21}H_{13}N$ (1,2-7,8-dibenzacridine).
Dibenz(a,j)acridine crystallizes as yellow needles. Sulfuric acid solutions of the compound exhibit greenish fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt: 279.35; mp: 216, solubility in water may be enhanced by the presence of acid impurities in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Acridines may be found in coal tar and pitch. They are associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71).

The average atmospheric urban concentration of dibenz(a,j)acridine in the United States is reported as 0.04 μg/1,000 m^3 (ref. 59).

The acridines are classified as weak bases.

TOXIC PROPERTIES, HEALTH EFFECTS:

Dibenz(a,j)acridine may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man, (refs. 85, 73). Dibenz(a,j)acridine is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3122. The lowest toxic dose to induce an oncogenic response is 11 mg/kg. The adjusted ordering number is 284.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 [for particulate polycyclic aromatic hydrocarbons (PPAH). This TLV recognizes the carcinogenic potential of PPAH collectively].

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/284 = 246$ μg/m^3
Water, Health: $15 \times 2.46 \times 10^2 = 3.70 \times 10^3$ μg/ℓ
Land, Health: $0.002 \times 3.70 \times 10^3 = 7.4$ μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 284) = 0.59$ μg/m^3
$EPC_{WC} = 15 \times 0.59 = 8.85$ μg/ℓ
$EPC_{LC} = 0.002 \times 8.85 = 0.02$ μg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.46E2		0.59		4×10^{-5}†
Water, $\mu g/l$ (ppm Wt)			3.7E3		8.85		
Land, $\mu g/g$ (ppm Wt)			7.4E0		0.02		

*To be multiplied by dilution factor

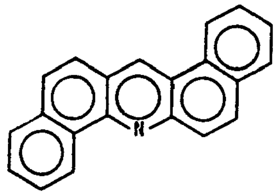
	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					0.59
Water, $\mu g/l$ (ppm Wt)					8.85
Land, $\mu g/g$ (ppm Wt)					0.02

†Reported for urban atmosphere. No rural concentration is reported.

CATEGORY: 23B

WLN: T G6 D6 B666 CNJ

STRUCTURE:



DIBENZ(a,h)ACRIDINE: $C_{21}H_{13}$(1,2-5,6-Dibenzacridine). Dibenz(a,h)acridine is obtained as yellow crystals from ethanol; solutions of the compound exhibit fluorescence.

PROPERTIES:

Molecular wt: 299.35; mp: 228; solubility in water may be enhanced by the presence of acids as impurities in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Acridines may be found in coal tar and pitch. They are associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71). The average atmospheric urban concentration of dibenz(a,h)acridine in the United States is reported as 0.08 μg/1,000 m^3 air (ref. 59).

The acridines are classified as weak bases.

TOXIC PROPERTIES, HEALTH EFFECTS:

Dibenz(a,h)acridine may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man (refs. 85, 73). Dibenz(a,h)acridine is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3124. The lowest toxic dose to induce a carcinogenic response is 10 mg/kg. The adjusted ordering number is 312.4.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 [for particulate polycyclic aromatic hydrocarbons (PPAH). This TLV recognizes the carcinogenic potential of PPAH collectively].

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/312.4 = 224$ μg/m^3

Water, Health: $15 \times 2.24 \times 10^2 = 3.36 \times 10^3$ μg/ℓ

Land, Health: $0.002 \times 3.36 \times 10^3 = 6.72$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 312.4) = 0.53$ μg/m^3

$EPC_{WC} = 15 \times 0.53 = 8.0$ μg/ℓ

$EPC_{LC} = 0.002 \times 8.0 = 0.016$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			2.2E2		0.53		8×10^{-5} †
Water, μg/l (ppm Wt)			3.36E3		8.0		
Land, μg/g (ppm Wt)			6.7E0		0.016		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)					0.53
Water, μg/l (ppm Wt)					8.0
Land, μg/g (ppm Wt)					0.016

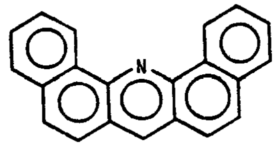
†Reported for urban atmosphere. No rural concentration is reported.

CATEGORY: 23B

WLN: T E6 D6 B666 CNJ

DIBENZ(c,h)ACRIDINE: $C_{21}H_{13}N$ (3,4-5,6(dibenzacridine)). Dibenz(c,h)acridine is obtained as yellow crystals from ethanol. Solutions of the compound exhibit fluorescence.

STRUCTURE:



PROPERTIES:

Molecular wt.: 279.35; mp: 189; sublimes; solubility in water may be enhanced by the presence of acids as impurities in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Acridines may be found in coal tar and pitch. They are associated with particulate polycyclic aromatic hydrocarbons, PPAH (ref. 71).

The acridines are classified as weak bases.

TOXIC PROPERTIES, HEALTH EFFECTS:

Dibenz(c,h)acridine may be present in soot, coal tar, and pitch, which are known to be carcinogenic to man (refs. 85, 73). Although not considered to be a highly active carcinogen alone, dibenz(c,h) acridine is included in the NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3122. The lowest dose to induce an oncogenic response is reported as 1,020 mg/kg. The adjusted ordering number is 3.06.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 [for particulate polycyclic aromatic hydrocarbons (PPAH). This TLV recognizes the carcinogenic potential of PPAH collectively].

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/3.06 = 2.3 \times 10^4$ µg/m^3

Water, Health: $15 \times 2.3 \times 10^4 = 3.45 \times 10^5$ µg/ℓ

Land, Health: $0.002 \times 3.45 \times 10^5 = 690$ µg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 3.06) = 54.5$ µg/m^3

$EPC_{WC} = 15 \times 54.5 = 817.5$ µg/ℓ

$EPC_{LC} = 0.002 \times 817.5 = 1.6$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.3E4		54.5		
Water, $\mu g/l$ (ppm Wt)			3.45E5		817.5		
Land, $\mu g/g$ (ppm Wt)			6.9E2		1.6		

*To be multiplied by dilution factor

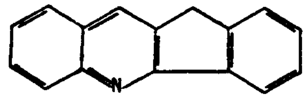
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					54.5
Water, $\mu g/l$ (ppm Wt)					817.5
Land, $\mu g/g$ (ppm Wt)					1.6

CATEGORY: 23B

2,3-BENZ-4-AZAFLUORENE: $C_{16}H_{11}N$ (11-Indeno(1,2-b)-quinoline)
Colorless needles from benzene.

WLN:

STRUCTURE:



PROPERTIES:

Molecular wt: 217; mp: 169-70; bp: 412.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

2,3-Benz-4-azafluorene is a constituent of anthracite pitch. It is associated with particulate polycyclic organic matter (ref. 71).

TOXIC PROPERTIES, HEALTH EFFECTS:

No information is available regarding toxic effects of carcinogenic potential for this compound alone.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health:
Water, Health:
Land, Health:

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)							
Water, $\mu g/l$ (ppm Wt)							
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

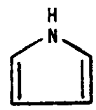
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					
Water, $\mu g/l$ (ppm Wt)					
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 23C

WLN: TSMJ

PYRROLE: C_4H_5N (1-aza-2,4-cyclopentadiene, azole, divinyleneimine).
Colorless liquid when freshly distilled, darkens on exposure to air, odor similar to that of chloroform.

STRUCTURE:



PROPERTIES:

Molecular wt: 67.10; bp: 130; d: 0.9691_4^{20}; vap. d.: 2.31; pK_b: 13.6 (ref. 41); sparingly soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Pyrrole occurs in coal tar and bone oil. The pyrrole ring is part of important, naturally occurring compounds, including haemin, chlorophyll, bile pigments, and many alkaloids (refs. 86,38).

TOXIC PROPERTIES, HEALTH EFFECTS:

Pyrrole is generally regarded as having a low degree of toxicity (ref. 41).
LD_{50} (subcutaneous, mouse): 61 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 61 = 2.7 \times 10^3$ µg/m³
Water, Health: $15 \times 2.7 \times 10^3 = 4.05 \times 10^4$ µg/ℓ
Land, Health: $0.002 \times 4.05 \times 10^4 = 81$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 61 = 6.5$ µg/m³
$EPC_{AH3} = 0.081 \times 61 = 5$ µg/m³
$EPC_{WH1} = 15 \times 5 = 75$ µg/ℓ
$EPC_{WH2} = 0.4 \times 61 = 24$ µg/ℓ
$EPC_{LH} = 0.002 \times 24 = 0.05$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.7E3		5		
Water, $\mu g/l$ (ppm Wt)			4.05E5		24		
Land, $\mu g/g$ (ppm Wt)			8.1E1		0.05		

*To be multiplied by dilution factor

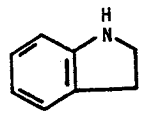
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			5		
Water, $\mu g/l$ (ppm Wt)			24		
Land, $\mu g/g$ (ppm Wt)			0.05		

CATEGORY: 23C

WLN: T56 BMJ

INDOLE: C_8H_7N (2,3-benzopyrrole, 1-azaindene, 1-benzazole). Colorless leaflets from water. Pleasant odor when pure.

STRUCTURE:



PROPERTIES:

Molecular wt: 117.09; mp: 52; bp: 253-4; soluble in hot water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Indole occurs in coal tar, in jasmine, orange blossom, and other flower oils, and with skatole in feces (ref. 87). Indole-3-acetic acid is an important plant growth hormone (ref. 88).

TOXIC PROPERTIES, HEALTH EFFECTS:

LD_{50} (oral, rat): 1,000 mg/kg.

Indole is included in NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3121. The lowest dose to induce an oncogenic response is reported as 480 mg/kg. The adjusted ordering number is 6.5.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/6.5 = 1.1 \times 10^4$ μg/m^3

Water, Health: $15 \times 1.1 \times 10^4 = 1.65 \times 10^5$ μg/ℓ

Land, Health: $0.002 \times 1.65 \times 10^5 = 330$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 1,000 = 107$ μg/m^3

$EPC_{AH3} = 0.081 \times 1,000 = 81$ μg/m^3

$EPC_{WH1} = 15 \times 81 = 1,200$ μg/ℓ

$EPC_{WH2} = 0.4 \times 1,000 = 400$ μg/ℓ

$EPC_{LH} = 0.002 \times 400 = 0.8$ μg/g

$EPC_{AC2} = 10^3/(6 \times 6.5) = 26$ μg/m^3

$EPC_{WC} = 15 \times 26 = 390$ μg/ℓ

$EPC_{LC} = 0.002 \times 390 = 0.8$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.1E4		26		
Water, $\mu g/l$ (ppm Wt)			1.65E5		390		
Land, $\mu g/g$ (ppm Wt)			3.3E2		0.8		

*To be multiplied by dilution factor

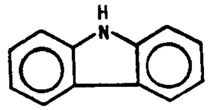
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			81		26
Water, $\mu g/l$ (ppm Wt)			400		390
Land, $\mu g/g$ (ppm Wt)			0.8		0.8

CATEGORY: 23C

WLN: T B656 HMJ

CARBAZOLE: $C_{12}H_9N$ (9-azafluorene, dibenzo(b,d)pyrrole, diphenyleneimine).
Colorless, slightly fluorescent plates.

STRUCTURE:



PROPERTIES:

Molecular wt: 167.20; mp: 245; bp: 355; d: 1.10_4^{18}; vap. press: 400 mm at 323°; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Carbazole occurs in anthracene oil of coal tar. Simple substituted carbazoles have been isolated from plants (ref. 88). It is a weaker base than diphenylamine (ref. 87).

Carbazole is associated with particulate polycyclic organic matter (ref. 71).

TOXIC PROPERTIES, HEALTH EFFECTS:

Carbazole is a known allergen (ref. 9).

LD_{50} (oral, rat): 500 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 500 = 2.25 \times 10^4$ $\mu g/m^3$

Water, Health: $15 \times 2.25 \times 10^4 = 3.4 \times 10^5$ $\mu g/\ell$

Land, Health: $0.002 \times 3.4 \times 10^5 = 680$ $\mu g/g$

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 500 = 54$ $\mu g/m^3$

$EPC_{AH3} = 0.081 \times 500 = 41$ $\mu g/m^3$

$EPC_{WH1} = 15 \times 41 = 615$ $\mu g/\ell$

$EPC_{WH2} = 0.4 \times 500 = 200$ $\mu g/\ell$

$EPC_{LH} = 0.002 \times 200 = 0.4$ $\mu g/g$

MULTIMEDIA ENVIRONMENTAL GOALS

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.25E4		41		
Water, $\mu g/l$ (ppm Wt)			3.4E5		200		
Land, $\mu g/g$ (ppm Wt)			6.8E2		0.4		

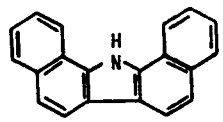
*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			41		
Water, $\mu g/l$ (ppm Wt)			200		
Land, $\mu g/g$ (ppm Wt)			0.4		

CATEGORY: 23C

WLN: T E6 D6 B566 CMJ

STRUCTURE:



DIBENZO(a,i)CARBAZOLE: $C_{20}H_{13}N$ (7H-dibenzo(a,i)carbazole, 1,2-7,8-dibenzocarbazole).
Colorless leaflets from acetic acid.

PROPERTIES:

Molecular wt: 267.34; mp: 221; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Carbazoles are in general weak bases (ref. 87). Simple substituted carbazoles have been isolated from plants (ref. 88).

The compound may be associated with particulate polycyclic organic matter.

TOXIC PROPERTIES, HEALTH EFFECTS:

Dibenzo(a,i)carbazole appears in NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3121. The lowest toxic dose to induce an oncogenic response is reported as 510 mg/kg. The adjusted ordering number is 6.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of ppah collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/6 = 1.2 \times 10^4$ $\mu g/m^3$	Air, Ecology:
Water, Health: $15 \times 1.2 \times 10^4 = 1.8 \times 10^5$ $\mu g/\ell$	Water, Ecology:
Land, Health: $0.002 \times 1.8 \times 10^5 = 360$ $\mu g/g$	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 6) = 28$ $\mu g/m^3$
$EPC_{WC} = 15 \times 28 = 420$ $\mu g/\ell$
$EPC_{LC} = 0.002 \times 420 = 0.8$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
Category	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.2E4		28		
Water, $\mu g/l$ (ppm Wt)			1.8E5		420		
Land, $\mu g/g$ (ppm Wt)			3.6E2		0.8		

*To be multiplied by dilution factor

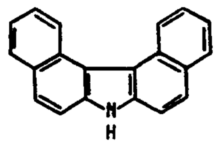
	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					28
Water, $\mu g/l$ (ppm Wt)					420
Land, $\mu g/g$ (ppm Wt)					0.8

CATEGORY: 23C

WLN: T D6 C6 B566 MMJ

DIBENZO(c,g)CARBAZOLE: $C_{20}H_{13}N$ (7H-Dibenzo(c,g)carbazole, 3,4-5,6-dibenzocarbazole)
Colorless needles from ethanol.

STRUCTURE:



PROPERTIES:

Molecular wt: 267.34; mp: 158; insoluble in water; lipid solubility: 0.3 mg/0.25 ml tricaprylin (ref. 73).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Carbazoles are, in general, weak bases (ref. 87). Simple substituted carbazoles have been isolated from plants (ref. 88).

Dibenzo(c,g)carbazole is associated with particulate polycyclic organic matter (ref. 71).

TOXIC PROPERTIES, HEALTH EFFECTS:

Dibenzo(c,g)carbazole is a carcinogen in the mouse, rat, hamster, and possibly in the dog (ref. 73). The EPA/NIOSH ordering number is 5429. The lowest dose to induce a carcinogenic response is reported as 8 mg/kg. The adjusted ordering number is 679.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/679 = 103\ \mu g/m^3$
Water, Health: $15 \times 103 = 1.5 \times 10^3\ \mu g/\ell$
Land, Health: $0.002 \times 1.5 \times 10^3 = 3\ \mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 679) = 0.24\ \mu g/m^3$
$EPC_{WC} = 15 \times 0.24 = 3.6\ \mu g/\ell$
$EPC_{LC} = 0.002 \times 3.6 = 0.007\ \mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.03E2		0.24		
Water, $\mu g/l$ (ppm Wt)			1.5E3		3.6		
Land, $\mu g/g$ (ppm Wt)			3.0E0		0.007		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

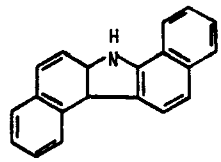
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					0.24
Water, $\mu g/l$ (ppm Wt)					3.6
Land, $\mu g/g$ (ppm Wt)					0.007

CATEGORY: 23C

WLN: T F6 C6 B566 MMJ

DIBENZO(a,g)CARBAZOLE: $C_{20}H_{13}N$ (7H-dibenzo(a,g)-carbazole, 1,2-5,6-dibenzocarbazole). Colorless needles from acetone.

STRUCTURE:



PROPERTIES:

Molecular wt: 267.34; mp: 231; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Carbazoles are in general weak bases (ref. 87). Simple substituted carbazoles have been isolated from plants (ref. 88). The compound may be associated with particulate polycyclic organic matter.

TOXIC PROPERTIES, HEALTH EFFECTS:

Dibenzo(a,g)carbazole appears in NIOSH Suspected Carcinogens List. The EPA/NIOSH ordering number is 3121. The lowest dose to induce a carcinogenic response is 270 mg/kg. The adjusted ordering number is 11.6.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (for particulate polycyclic aromatic hydrocarbons [PPAH]. This TLV recognizes the carcinogenic potential of PPAH collectively).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/11.6 = 6 \times 10^3$ µg/m^3
Water, Health: $15 \times 6 \times 10^3 = 9 \times 10^4$ µg/ℓ
Land, Health: $0.002 \times 9 \times 10^4 = 180$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AC2} = 10^3/(6 \times 11.6) = 14$ µg/m^3
$EPC_{WC} = 15 \times 14 = 210$ µg/ℓ
$EPC_{LC} = 0.002 \times 210 = 0.4$ µg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			6.0E3		14		
Water, $\mu g/l$ (ppm Wt)			9.0E4		210		
Land, $\mu g/g$ (ppm Wt)			1.8E2		0.4		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

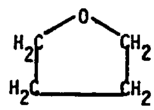
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					14
Water, $\mu g/l$ (ppm Wt)					210
Land, $\mu g/g$ (ppm Wt)					0.4

CATEGORY: 24

WLN: T5OTJ

TETRAHYDROFURAN: C_4H_8O (1,4-epoxybutane, cyclotetramethylene oxide).
Colorless liquid; penetrating odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 72.12; bp: 64-5; d: 0.888; vap. press: 114 mm at 15° C; vap. d: 2.5; miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Tetrahydrofuran decomposes slowly with formation of peroxides. The ring is easily cleaved by acids and other reagents (ref. 89). Tetrahydrofuran is widely used as a solvent.

TOXIC PROPERTIES, HEALTH EFFECTS:

Tetrahydrofuran is reported to cause irritation to the upper respiratory tract and injury to the liver and kidneys of experimental animals when exposed for 20 days to concentrations of 3,000 ppm (ref. 4).

Exposure to concentrations of 25,000 ppm is reported to cause damage to the central nervous system in humans (ref. 2). Exposure to a concentration of 200 ppm is not expected to have a systemic effect in humans (ref. 4).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 590 mg/m^3 (200 ppm)

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 5.9×10^5 µg/m^3 (200 ppm)
Water, Health: $15 \times 5.9 \times 10^5 = 9 \times 10^6$ µg/ℓ
Land, Health: $0.002 \times 9 \times 10^6 = 1.8 \times 10^4$ µg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 590/420 = 1{,}400$ µg/m^3
$EPC_{AH1a} = 200/420 = 0.5$ ppm
$EPC_{WH1} = 15 \times 1{,}400 = 21{,}000$ µg/ℓ
$EPC_{WH2} = 13.8 \times 590 = 8{,}100$ µg/ℓ
$EPC_{LH} = 0.002 \times 8{,}100 = 16$ µg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.9E5 (200)		1,400 (0.5)		
Water, $\mu g/l$ (ppm Wt)			9.0E6		8,100		
Land, $\mu g/g$ (ppm Wt)			1.8E4		16		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

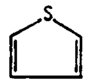
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			1,400 (0.5)		
Water, $\mu g/l$ (ppm Wt)			8,100		
Land, $\mu g/g$ (ppm Wt)			16		

CATEGORY: 25

WLN: T5SJ

THIOPHENE: C_4H_4S (thiofuran).
Clear, colorless liquid; disagreeable odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 84.14; mp: 29.8; bp: 84; d: 1.06494;
vap. press: 40 mm at 12.5°; vap. d: 2.9.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Thiophene occurs in small amounts in coal tar. Pyrolysis of thiophene at 800° to 825° gives methane, hydrogen sulfide, and hydrogen as the only gaseous products. In the presence of orthophosphoric acid, thiophene polymerizes to give oligomers (ref. 90).

TOXIC PROPERTIES, HEALTH EFFECTS:

No information is available on the possible toxic effects of thiophene.
LC_{Lo} (inhalation, mouse): 8,700 ppm
LD_{Lo} (intraperitoneal, mouse): 100 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 100 = 4.5 \times 10^3$ μg/m³
Water, Health: $15 \times 4.5 \times 10^3 = 6.75 \times 10^4$ μg/ℓ
Land, Health: $0.002 \times 6.75 \times 10^5 = 1.35 \times 10^2$ μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 100 = 11$ μg/m³
$EPC_{AH3} = 0.081 \times 100 = 8$ μg/m³
$EPC_{WH1} = 15 \times 8 = 120$ μg/ℓ
$EPC_{WH2} = 0.4 \times 100 = 40$ μg/ℓ
$EPC_{LH} = 0.002 \times 40 = 0.08$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.5E3		8		
Water, $\mu g/l$ (ppm Wt)			6.75E4		40		
Land, $\mu g/g$ (ppm Wt)			1.35E2		0.08		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			8		
Water, $\mu g/l$ (ppm Wt)			40		
Land, $\mu g/g$ (ppm Wt)			0.08		

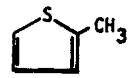
CATEGORY: 25

WLN: T5SJ B, T5SJ C

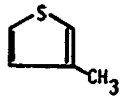
METHYLTHIOPHENES:

2-methylthiophene, C_5H_6S.
3-methylthiophene, C_5H_6S.
Colorless liquids, disagreeable odor.

STRUCTURE:



2-Methylthiophene



3-Methylthiophene

PROPERTIES:

Molecular wt: 98; bp: 112, $114^{738\ mm}$.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

2-Methylthiophene and 3-methylthiophene are found in coal tar. Methylthiopenes polymerize at high temperatures to form oligomers. Oxidation of alkyl thiophenes gives thiophenecarboxylic acids in low yield (ref. 90).

TOXIC PROPERTIES, HEALTH EFFECTS:

No information is available on the possible toxic effects of methylthiophenes.
LD_{50} (intraperitoneal, mouse): 500 mg/kg for 2-methylthiophene.
LD_{50} (intraperitoneal, mouse): 512 mg/kg for 3-methylthiophene.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 500 = 2.25 \times 10^4\ \mu g/m^3$
Water, Health: $15 \times 2.25 \times 10^4 = 3.4 \times 10^5\ \mu g/\ell$
Land, Health: $0.002 \times 3.4 \times 10^5 = 700\ \mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 500 = 54\ \mu g/m^3$
$EPC_{AH3} = 0.081 \times 500 = 41\ \mu g/m^3$
$EPC_{WH1} = 15 \times 41 = 615\ \mu g/\ell$
$EPC_{WH2} = 0.4 \times 500 = 200\ \mu g/\ell$
$EPC_{LH} = 0.002 \times 200 = 0.4\ \mu g/g$

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.25E4		41		
Water, $\mu g/l$ (ppm Wt)			3.4E5		200		
Land, $\mu g/g$ (ppm Wt)			7.0E2		0.4		

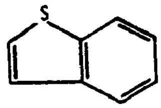
*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			41		
Water, $\mu g/l$ (ppm Wt)			200		
Land, $\mu g/g$ (ppm Wt)			0.4		

CATEGORY: 25

WLN: T56 BSJ

STRUCTURE:



BENZO(b)THIOPHENE: C_8H_6S (benzothiofuran, 2,3-benzothiophene, thionaphthene).
Colorless liquid; naphthalene-like odor.

PROPERTIES:

Molecular wt: 134.20; mp: 32; bp: 221-2; volatile in steam; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Benzo(b)thiophene is present in lignite tar.

TOXIC PROPERTIES, HEALTH EFFECTS:

No information is available on the possible toxic effects of benzo(b)thiophene.

LD_{Lo} (intraperitoneal, mouse): 512 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 512 = 2.3 \times 10^4$ μg/m³
Water, Health: $15 \times 2.3 \times 10^4 = 3.5 \times 10^5$ μg/ℓ
Land, Health: $0.002 \times 3.5 \times 10^5 = 700$ μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 512 = 55$ μg/m³
$EPC_{AH3} = 0.081 \times 512 = 41$ μg/m³
$EPC_{WH1} = 15 \times 41 = 615$ μg/ℓ
$EPC_{WH2} = 0.4 \times 512 = 205$ μg/ℓ
$EPC_{LH} = 0.002 \times 205 = 0.4$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.3E4		41		
Water, $\mu g/l$ (ppm Wt)			3.5E5		205		
Land, $\mu g/g$ (ppm Wt)			7.0E2		0.4		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			41		
Water, $\mu g/l$ (ppm Wt)			205		
Land, $\mu g/g$ (ppm Wt)			0.4		

CATEGORY: 26A

WLN: 1 4-PB-

TETRAMETHYLLEAD: $C_4H_{12}Pb$ (tetramethylplumbane).
A colorless liquid.

STRUCTURE:
$(CH_3)_4Pb$

PROPERTIES:

Molecular wt: 267.35; mp: 242.92° K; bp: 101;
d: 1.99; vap. press: 50 mm at 33.2° C; vap. d: 9.2.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Tetramethyllead is a common additive for gasoline, and thus a common air pollutant. For urban and rural concentrations of lead, see category 46.

Tetramethyllead does not occur in nature (ref. 91).

TOXIC PROPERTIES, HEALTH EFFECTS:

Tetramethyllead is a highly toxic compound. It can be absorbed by inhalation or skin contact. There is some evidence that tetramethyllead is less toxic in man than tetraethyllead (ref. 92). Tetramethyllead is more volatile than tetraethyllead, but no apparent difference has been found in the levels of lead in the urine of workers exposed to either compound (ref. 4). No specific indication of carcinogenicity has been reported.

LD_{50} (oral, rat): 109 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.150 mg/m^3 (0.014 ppm).
Lead compounds are included in the EPA Consent Decree Priority 1 List.
See also Lead and Lead Compounds as Lead, category 46.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 150 μg/m^3 (0.014 ppm)
Water, Health: 15 x 150 = 2.25 x 10^3 μg/ℓ
Land, Health: 0.002 x 2.25 x 10^3 = 4.5 μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH1} = 10^3 x 0.15/420 = 0.36 μg/m^3
EPC_{AH1a} = 0.014/420 = 3 x 10^{-5} ppm
EPC_{WH1} = 15 x 0.36 = 5 μg/ℓ
EPC_{WH2} = 13.8 x 0.15 = 2 μg/ℓ
EPC_{LH} = 0.002 x 2 = 0.004 μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.5E2 (0.014)		0.36 (3×10^{-5})		
Water, $\mu g/l$ (ppm Wt)			2.25E3		2		
Land, $\mu g/g$ (ppm Wt)			4.5E0		0.004		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.36 (3×10^{-5})		
Water, $\mu g/l$ (ppm Wt)			2		
Land, $\mu g/g$ (ppm Wt)			0.004		

CATEGORY: 26A

WLN: 2-PB-2&2&2

TETRAETHYLLEAD: $C_8H_{20}Pb$ (tetraethylplumbane).
A colorless, oily liquid; pleasant odor.

STRUCTURE:

$(C_2H_5)_4Pb$

PROPERTIES:

Molecular wt: 323.45; six polymorphic forms; mp: 135.6-141° K; bp: 198-200 with decomposition; d: 1.659 at 18°; vap. press: 1 mm at 38.4; 50 mm at 108.4° C; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Tetraethyllead is a common additive for gasolines. It decomposes under ultraviolet light to triethyllead (ref. 9). Both tetraethyl and triethyllead are toxic and are known air contaminants. See category 46. The tetraethyllead in gasolines is usually converted to lead halides or lead phosphates (ref. 91). Some unchanged tetraethyllead enters the urban atmosphere and finds its way to soils and plants. At 800 m from a manufacturing plant, tetraethyllead was found in plants at a level of 1 mg/kg (ref. 91).

Tetraethyllead decomposes slowly at room temperature and more rapidly at elevated temperatures (ref. 91). Tetraethyllead does not occur in nature (ref. 91).

TOXIC PROPERTIES, HEALTH EFFECTS:

Tetraethyllead is a highly toxic compound. It can be absorbed by inhalation or skin contact. The main metabolite found in rats is triethyllead (ref. 92). A concentration of 100 mg/m^3 for 1 hour may produce illness (refs. 4, 92). In cases of accidental tetraethyllead intoxication in man, lead levels in urine are high, but may be normal or nearly so in blood (ref. 92). Tetraethyllead is considered to be more toxic in man than tetramethyllead (ref. 92).

LD_{Lo} (oral, rat): 17 mg/kg

LC_{50} (inhalation, rat): 6 ppm or 79 mg/m^3

Tetraethyllead is reported to cause cancer in mice. The EPA/NIOSH ordering number is 3101. The lowest dose to induce a carcinogenic response is reported as 86 mg/kg. The adjusted ordering number is 36.

Aquatic toxicity: 96 hr. TLm: <1 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.100 mg/m^3 (0.0075 ppm).

Lead compounds are included in the EPA Consent Decree Priority 1 List.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 100 $\mu g/m^3$ (0.0075 ppm)

Water, Health: $15 \times 100 = 1.5 \times 10^3$ $\mu g/\ell$

Land, Health: $0.002 \times 1.5 \times 10^3 = 3$ $\mu g/g$

Air, Ecology:

Water, Ecology: $100 \times <1 = <100$ $\mu g/\ell$

Land, Ecology: $0.002 \times 100 = 0.2$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.1/420 = 0.24\ \mu g/m^3$

$EPC_{AH1a} = 0.0075/420 = 1.8 \times 10^{-5}$ ppm

$EPC_{WH1} = 15 \times 0.24 = 3.6\ \mu g/\ell$

$EPC_{WH2} = 13.8 \times 0.1 = 1.4\ \mu g/\ell$

$EPC_{LH} = 0.002 \times 1.4 = 0.003\ \mu g/g$

$EPC_{AC2} = 10^3/(6 \times 36) = 4.6\ \mu g/m^3$

$EPC_{WC} = 15 \times 4.6 = 70\ \mu g/\ell$

$EPC_{LC} = 0.002 \times 70 = 0.14\ \mu g/g$

$EPC_{WE1} = 50 \times <1 = <50\ \mu g/\ell$

$EPC_{LE} = 0.002 \times 50 = 0.1\ \mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E2 (0.0075)		0.24 (1.8×10^{-5})		
Water, $\mu g/l$ (ppm Wt)			1.5E3	<1.0E2	1.4	<50	
Land, $\mu g/g$ (ppm Wt)			3.0E0	2.0E-1	0.003	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.24 (1.8×10^{-5})		4.6
Water, $\mu g/l$ (ppm Wt)			1.4	< 50	70
Land, $\mu g/g$ (ppm Wt)			0.003	0.1	0.14

CATEGORY: 26A

ALKYL MERCURY

MONOMETHYLMERCURY, $(CH_3Hg^+)_2$

DIMETHYLMERCURY, $(CH_3)_2Hg$

Dimethylmercury is volatile.

WLN:

STRUCTURE:

$H_3C\text{-}Hg\text{-}CH_3$ Dimethylmercury

$(H_3C\text{-}Hg^+)_2$ Monomethylmercury

PROPERTIES:

(Dimethlmercury) Molecular wt: 230.66; bp: 96;
d: 3.069; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Methylmercury compounds are the most common alkylmercury compounds. Dimethylmercury and monomethylmercury are of concern primarily as water pollutants or as contaminants in the tissues of animals; they have been found in fish and in bird flesh and also in bottom sediments (ref. 24). In large fish the ratio of methylmercury to total mercury is high, approaching 100 percent (refs. 93,94). The natural concentration of mercury in seawater is about 0.1 μg/ℓ (ref. 28). This concentration includes alkylmercury as well as the other compounds of mercury. Mercury tends to accumulate in bottom sediments of streams, where certain microbes may synthesize monomethyl and dimethylmercury from mercury ions (ref. 94). Continuous levels of monomethylmercury in the water may result. The process of methylation may be significant in the uptake and distribution of mercury in fish and in the mobilization of mercury in deposits in bottom sediments into the general environment (ref. 94).

The amount of methylmercury compounds found in plant produce is very small or nil (ref. 93).

TOXIC PROPERTIES, HEALTH EFFECTS:

Alkylmercury compounds are the mercury compounds most toxic to man. The biological half-life of monomethylmercury in man is reported to be 70 days.

Monomethylmercury has been associated with teratogenic effects: An epidemic of cerebral palsy with toxic encephalopathy occurred in Minimoto, Japan, and the cause was felt to be maternal ingestion of fish contaminated with monomethylmercury (ref. 32). (Since levels of methylmercury resulting in the teratogenic effects are not reported, an adjusted ordering number cannot be calculated.)

Mercury concentrates in the brain, liver, and kidneys of livestock as alkylmercury; the mercury level in tissues should not exceed 0.5 ppm (ref. 28). Organomercurials can cause skin burns, and can also be absorbed through the skin (ref. 9).

Bioaccumulation of monomethylmercury in aquatic organisms results from mercury in the water and from ingested food. Biological accumulation from water may be as high as 10,000 times (ref. 28).

The biological half-life of monomethylmercury in fish may be on the order of 2 years (ref. 28).

Toxicity to fish: 0.2 μg/ℓ of monomethylmercury is lethal to fathead minnows in 6 weeks; 0.1 μg/ℓ affects some phytoplankton (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

On EPA Consent Decree Priority I List.

TLV = 0.01 mg/m^3 (0.001 ppm) for alkyl mercury, as mercury.

Food and Drug Administration Guideline: Maximum allowable concentration of mercury in edible portions of fish: 0.5 μg/g (ref. 28).

See also category 83 for additional regulations for mercury.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 10 μg/m^3 (0.001 ppm)

Water, Health: 15 x 10 = 150 μg/ℓ

Land, Health: 0.002 x 150 = 0.3 μg/g

Air, Ecology:

Water, Ecology: 0.1 x 0.2 = 0.02 μg/ℓ

Land, Ecology: 0.002 x 0.02 = 4×10^{-5} μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.01/420 = 0.024$ μg/m^3

$EPC_{AH1a} = 0.001/420 = 2.4 \times 10^{-6}$ ppm

$EPC_{WH1} = 15 \times 0.024 = 0.36$ μg/ℓ

$EPC_{WH2} = 13.8 \times 0.01 = 0.14$ μg/ℓ

$EPC_{LH} = 0.002 \times 0.14 = 0.0003$ μg/g

$EPC_{WE1} = 0.05 \times 0.2 = 0.01$ μg/ℓ

$EPC_{WE3} = 500/10{,}000 = 0.05$ μg/ℓ

$EPC_{LE} = 0.002 \times 0.01 = 2 \times 10^{-5}$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E1 (0.001)		0.024 (2.4×10^{-6})		
Water, µg/l (ppm Wt)			1.5E2	2.0E-2	0.14	0.01	0.1†
Land, µg/g (ppm Wt)			3.0E-1	4.0E-5	0.0003	2×10^{-5}	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.024 (2.4×10^{-6})		
Water, µg/l (ppm Wt)			0.14	0.01	
Land, µg/g (ppm Wt)			0.0003	2×10^{-5}	

†Concentrations of Hg in seawater.

CATEGORY: 26A

ORGANOTIN COMPOUNDS: (i.e., mono, di, tri, and tetraalkyltin or aryltin derivatives).

WLN:

STRUCTURE:

R_4Sn R_2Sn^{++}

R_3Sn^{+} R_1Sn^{+++}

Where R is an aryl or alkyl group.

PROPERTIES:

Tetramethyltin: bp: 76.6; mp: -55; d.: 1.2905^{25}.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Organotin compounds find use as fungicides, insecticides, insect chemosterilant, antifouling agents, and for killing parasitic worms.

As fungicides they are used to dust potatoes and sugar beet crops. The short half-life of the compounds in the field and the fact that they do not penetrate the plant makes them safe for this application (ref. 95).

TOXIC PROPERTIES, HEALTH EFFECTS:

Organotin compounds may be absorbed through the skin. Human deaths have resulted from oral use of organotin compounds in the treatment of skin disorders (ref. 96). The toxicity of the dialkyltin compounds is characterized by their irritative action and production of a lesion of the bile duct and liver (ref. 96). Trialkyltin compounds differ from dialkyl derivatives in that their toxicity is manifested by an apparent brain damage (ref. 96). Tetraalkyltin compounds are toxic to mammals. Toxic symptoms develop slowly and death may occur a long time after exposure. There is some evidence that tetraalkyltins are converted into trialkyltins in mammals (ref. 95).

LD_{50} (oral, rat): 16 mg/kg for tetraethyltin.

Some trialkyltin compounds are quite toxic to higher plants (ref. 95).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.1 mg/m^3 as Sn (for organotin compounds).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 100 μg/m^3

Water, Health: 15 x 100 = 1,500 μg/ℓ

Land, Health: 0.002 x 1,500 = 3 μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.1/420 = 0.24$ μg/m^3

$EPC_{WH1} = 15 \times 0.24 = 3.6$ μg/ℓ

$EPC_{WH2} = 13.8 \times 0.1 = 1.4$ μg/ℓ

$EPC_{LH} = 0.002 \times 1.4 = 0.003$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.0E2		0.24		
Water, μg/l (ppm Wt)			1.5E3		1.4		
Land, μg/g (ppm Wt)			3.0E0		0.003		

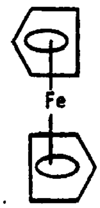
*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			0.24		
Water, μg/l (ppm Wt)			1.4		
Land, μg/g (ppm Wt)			0.003		

CATEGORY: 26B

WLN: L5 AHJ A-2 Fe-

STRUCTURE:



FERROCENE: $C_{10}H_{10}Fe$ (dicyclopentadienyliron). Orange-yellow crystalline solid.

PROPERTIES:

Molecular wt: 186.05; mp: 173; sublimes >100°; insoluble in water; volatile in steam.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Ferrocene may form directly by the reaction of cyclopentadiene and iron under pressure. The compound decomposes upon heating.

TOXIC PROPERTIES, HEALTH EFFECTS:

No information is available as to the possible carcinogenic effects of ferrocene.

LD_{50} (oral, rat): 1,320 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 1{,}320 = 6.0 \times 10^4$ μg/m^3

Water, Health: $15 \times 6 \times 10^4 = 9.0 \times 10^5$ μg/ℓ

Land, Health: $0.002 \times 9.0 \times 10^5 = 1.8 \times 10^3$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 1{,}320 = 140$ μg/m^3

$EPC_{AH3} = 0.081 \times 1{,}320 = 107$ μg/m^3

$EPC_{WH1} = 15 \times 107 = 1{,}600$ μg/ℓ

$EPC_{WH2} = 0.4 \times 1{,}320 = 530$ μg/ℓ

$EPC_{LH} = 0.002 \times 530 = 1$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			6.0E4		107		
Water, $\mu g/l$ (ppm Wt)			9.0E5		530		
Land, $\mu g/g$ (ppm Wt)			1.8E3		1		

*To be multiplied by dilution factor

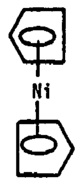
AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			107		
Water, $\mu g/l$ (ppm Wt)			530		
Land, $\mu g/g$ (ppm Wt)			1		

CATEGORY: 26B

WLN: L50J 0-2-NI-

NICKELOCENE: $C_{10}H_{10}Ni$ (di-cyclopentadienylnickel). Green needles from petroleum ether.

STRUCTURE:



PROPERTIES:

Molecular wt: 189; mp: 171-173; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

TOXIC PROPERTIES, HEALTH EFFECTS:

LD_{50} (oral, rat): 490 mg/kg.

Nickelocene is reported to cause cancer in animals. The EPA/NIOSH ordering number is 4202. The lowest dose to induce a carcinogenic response is reported as 208 mg/kg. The adjusted ordering number is 20.2.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Nickel compounds are included in the EPA Consent Decree List, Priority 1.

See also Nickel and Nickel Compounds, as Nickel, category 76.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/20.2 = 3.5 \times 10^3$ µg/m^3

Water, Health: $15 \times 3.5 \times 10^3 = 5.2 \times 10^4$ µg/ℓ

Land, Health: $0.002 \times 5.2 \times 10^4 = 100$ µg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 490 = 52$ µg/m^3

$EPC_{AH3} = 0.081 \times 490 = 40$ µg/m^3

$EPC_{WH1} = 15 \times 40 = 600$ µg/ℓ

$EPC_{WH2} = 0.4 \times 490 = 200$ µg/ℓ

$EPC_{LH} = 0.002 \times 200 = 0.4$ µg/g

$EPC_{AC2} = 10^3/(6 \times 20.2) = 8$ µg/m^3

$EPC_{WC} = 15 \times 8 = 120$ µg/ℓ

$EPC_{LC} = 0.002 \times 120 = 0.2$ µg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, µg/m³ (ppm Vol)			3.5E3		8		
Water, µg/l (ppm Wt)			5.2E4		120		
Land, µg/g (ppm Wt)			1.0E2		0.2		

*To be multiplied by dilution factor

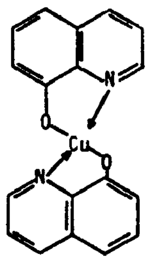
AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, µg/m³ (ppm Vol)			40		8
Water, µg/l (ppm Wt)			200		120
Land, µg/g (ppm Wt)			0.4		0.2

CATEGORY: 26C

WLN: T66 BNJ JO 2-CU-

STRUCTURE:



COPPER 8-HYDROXYQUINOLINE: $C_{18}H_{12}N_2O_2Cu$ (8-quinolinol-copper II chelate).
Intense blue crystals.

PROPERTIES:

Molecular wt: 351.86; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Copper complexes of synthetic origin are of interest in the study of binding of copper to proteins and enzymes (ref. 97).

TOXIC PROPERTIES, HEALTH EFFECTS:

Copper is an essential trace metal for animals and man, but minute amounts in water are toxic for algae, bacteria, and other unicellular forms (ref. 96).

LD_{50} (intraperitoneal, mouse): 67 mg/kg.

Copper 8-hydroxyquinoline is reported to cause cancer in mice. The EPA/NIOSH ordering number is 3101. The lowest dosage to induce an oncogenic response is reported as 156 mg/kg. The EPA/NIOSH adjusted ordering number is 20.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Copper compounds are on EPA Consent Decree List: Priority 3.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 67 = 3.0 \times 10^3$ μg/m³

Water, Health: $15 \times 3 \times 10^3 = 4.5 \times 10^4$ μg/ℓ

Land, Health: $0.002 \times 4.5 \times 10^4 = 90$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 67 = 7$ μg/m³

$EPC_{AH3} = 0.081 \times 67 = 5$ μg/m³

$EPC_{WH1} = 15 \times 5 = 75$ μg/ℓ

$EPC_{WH2} = 0.4 \times 67 = 27$ μg/ℓ

$EPC_{LH} = 0.002 \times 27 = 0.054$ μg/g

$EPC_{AC2} = 10^3/(6 \times 20) = 8.3$ μg/m³

$EPC_{WC} = 15 \times 8.3 = 125$ μg/ℓ

$EPC_{LC} = 0.002 \times 125 = 0.25$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.0E3		5		
Water, $\mu g/l$ (ppm Wt)			4.5E4		27		
Land, $\mu g/g$ (ppm Wt)			9.0E1		0.054		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			5		8.3
Water, $\mu g/l$ (ppm Wt)			27		125
Land, $\mu g/g$ (ppm Wt)			0.054		0.25

CATEGORY: 27

WLN: LI

LITHIUM AND LITHIUM COMPOUNDS (AS LITHIUM): Li.

A silver-gray metal; the first member of the alkali metals.

STRUCTURE:

Li Li^+

PROPERTIES:

Atomic number: 3; group 1a; atomic wt: 6.94; mp: 180.5; bp: 1,336 ±5; d: 0.534^{20}; valency: +1; decomposes H_2O, evolving H_2; vap. press: 1 mm at 723°.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Lithium is the lightest of the nongaseous elements and is very reactive.

Lithium forms one series of compounds. Practically all of them are water-soluble.

The concentration of lithium in rural atmosphere is reported to be 0.0029 µg/m³ (ref. 1).

Occurrence in the Earth's crust of lithium is 0.005 percent by weight (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

The lithium ion is highly toxic to humans. Levels above 25 µg/m³ of lithium hydride cause sneezing (ref. 64). Lithium is noncumulative (ref. 98). Lithium toxicity in humans is partially dependent on sodium intake; the lower the sodium intake, the more toxic lithium becomes (ref. 96).

A dosage of 350 mg/kg is reported to produce teratogenic effects in rats. The EPA/NIOSH ordering number based on teratogenicity is 4101 and the adjusted ordering number is 11.4.

Lithium is a phytotoxic element. The most sensitive plant species is citrus; a slight toxicity in citrus results at 60 to 100 µg/ℓ in irrigation water (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (Lithium Hydride, LiH): 0.025 mg/m³. (This is equivalent to 0.022 mg/m³, as lithium.)

NAS/NAE Water Quality Criteria, 1972, recommendations are for irrigation water, based on phytotoxicity: 2.5 mg/ℓ for use on all soils, except for citrus; 0.075 mg/ℓ for citrus for all soils (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 22 µg/m³

Water, Health: 15 x 22 = 330 µg/ℓ

Land, Health: 0.002 x 330 = 0.7 µg/g

Air, Ecology:

Water, Ecology: 5 x 75 = 375 µg/ℓ

Land, Ecology: 0.002 x 375 = 0.75 µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.022/420 = 0.05\ \mu g/m^3$

$EPC_{WH1} = 15 \times 0.05 = 0.75\ \mu g/\ell$

$EPC_{WH2} = 13.8 \times 0.022 = 0.3\ \mu g/\ell$

$EPC_{LH} = 0.002 \times 0.3 = 0.0006\ \mu g/g$

$EPC_{WES} = 75\ \mu g/\ell$ (for irrigation)

$EPC_{LE} = 0.002 \times 75 = 0.15\ \mu g/g$

$EPC_{AT} = 10^3(6 \times 11.4) = 14.6\ \mu g/m^3$

$EPC_{WT} = 15 \times 14.6 = 219\ \mu g/\ell$

$EPC_{LT} = 0.002 \times 219 = 0.4\ \mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.2E1		0.05		0.003
Water, $\mu g/l$ (ppm Wt)			3.30E2	3.75E2	0.3	75	
Land, $\mu g/g$ (ppm Wt)			7.0E-1	7.5E-1	0.0006	0.15	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.05		14.6
Water, $\mu g/l$ (ppm Wt)		75	0.3		219
Land, $\mu g/g$ (ppm Wt)			0.0006	0.15	0.4

CATEGORY: 27

WLN: LI H

LITHIUM HYDRIDE: LiH.

White, translucent, crystalline mass; darkens on exposure to light.

STRUCTURE:

LiH

PROPERTIES:

Molecular wt: 7.95; mp: 680; d: 0.82; decomposes in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Lithium hydride is a stable saltlike compound. It is formed when lithium and hydrogen are combined at elevated temperatures.

Lithium hydride reacts with water to form lithium hydroxide (LiOH) and hydrogen.

TOXIC PROPERTIES, HEALTH EFFECTS:

Toxicity of lithium hydride for experimental animals is marked by irritation and corrosiveness (ref. 96).

Levels above 25 $\mu g/m^3$ of lithium hydride produce sneezing. Levels exceeding 10 mg/m^3 eroded body fur and skin on test animals (ref. 4).

LD_{Lo} (inhalation, rat): 22 mg/m^3 for 4 hours.

See also Lithium and Lithium Compounds, as Lithium.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.025 mg/m^3.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 25 $\mu g/m^3$	Air, Ecology:
Water, Health: $15 \times 25 = 375$ $\mu g/\ell$	Water, Ecology:
Land, Health: $0.002 \times 375 = 0.75$ $\mu g/g$	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.025/420 = 0.06$ $\mu g/m^3$

$EPC_{WH1} = 15 \times 0.06 = 0.9$ $\mu g/\ell$

$EPC_{WH2} = 13.8 \times 0.025 = 0.3$ $\mu g/\ell$

$EPC_{LH} = 0.002 \times 0.3 = 0.0006$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.5E1		0.06		
Water, $\mu g/l$ (ppm Wt)			3.75E2		0.3		
Land, $\mu g/g$ (ppm Wt)			7.5E-1		0.0006		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.06		
Water, $\mu g/l$ (ppm Wt)			0.3		
Land, $\mu g/g$ (ppm Wt)			0.0006		

CATEGORY: 29

WLN: KA

POTASSIUM AND POTASSIUM COMPOUNDS (AS POTASSIUM): K (kalium). Soft, ductile, silver-white, very reactive metal.

STRUCTURE:

K Ka^{+}

PROPERTIES:

Atomic number: 19; group 1a; atomic wt: 39.09; mp: 63.65; bp: 765; d: 0.862; soluble; vap. press: 8 mm at 432° C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Potassium is an alkali-metal element, which reacts violently with water forming potassium hydroxide (KOH) and hydrogen. It oxidizes rapidly in air.

Rural background concentration in air is 0.4 to 2.8 $\mu g/m^3$ (ref. 1). The mean potassium concentration in analyses of U.S. surface water is 4.3 mg/ℓ with a range of 370 to 0.06 mg/ℓ (ref. 28).

Potassium is considered an essential nutrient for plants and necessary for animals.

Occurrence in the Earth's crust is 2.59 percent by weight (ref. 24).

Potassium salts are common in feldspars, salt deposits, and naturally occurring brines (ref. 99).

TOXIC PROPERTIES, HEALTH EFFECTS:

The toxicity of potassium compounds is almost always that of the anion (ref. 9).

Exposure to dust or mist of potassium hydroxide causes eye and respiratory tract irritation and nasal septum lesions (ref. 4).

LD_{Lo} (oral, rat) potassium chloride = 2,430 mg/kg.

Aquatic toxicity: 432 ppm KCl is threshold of immobilization for Daphnia magna (ref. 28). This is equivalent to 230 ppm, as K^{+}.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (for potassium hydroxide, KOH): 2 mg/m^3.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2×10^3 $\mu g/m^3$ as KOH

Water, Health: $15 \times 2 \times 10^3 = 3.0 \times 10^4$ $\mu g/\ell$, as KOH

Land, Health:

Air, Ecology:

Water, Ecology: $100 \times 230 = 2.3 \times 10^4$ $\mu g/\ell$ as K

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 2/420 = 5$ $\mu g/m^3$ as KOH

$EPC_{WH1} = 15 \times 5 = 75$ $\mu g/\ell$ as KOH

$EPC_{WE1} = 50 \times 432 = 21{,}600$ $\mu g/\ell$ as KCl

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.0E3†		5†		0.4-2.8
Water, $\mu g/l$ (ppm Wt)			3.0E4†	4.3E4‡	75	21,600‡	4,300
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			5†		
Water, $\mu g/l$ (ppm Wt)			75†	21,600‡	
Land, $\mu g/g$ (ppm Wt)					

†, as KOH
‡, as KCl

CATEGORY: 32

WLN: .BE

BERYLLIUM AND BERYLLIUM COMPOUNDS (AS BERYLLIUM): Be (gluicinium).

A hard, light, grayish-white, crystalline metal.

STRUCTURE:

Be Be^{+2}

PROPERTIES:

Atomic number: 4; group 2a; atomic wt: 9.0122;
mp: 1283; bp: 2970; d: 1.85; valency: +2; insoluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Beryllium resembles magnesium and aluminum in its chemical properties. It is divalent and forms one series of compounds. Beryllium is environmentally hazardous as an air contaminant. The chloride and nitrate are highly soluble in water.

Rural background concentration in air is reported as 0.00013 to 0.000042 $\mu g/m^3$ (ref.1)

Concentrations of beryllium in freshwater in the United States have been measured ranging 0.01 to 1.22 $\mu g/\ell$ with a mean of 0.19 $\mu g/\ell$ (ref. 28). Natural concentration in seawater is reported as 6×10^{-4} $\mu g/\ell$ (ref. 28).

Occurrence in the earth's crust is 2 to 10 ppm (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

Beryllium is toxic through all routes of absorption, but the major hazard to health is via inhalation. Berylliosis, a severe lung disease, develops from chronic exposure to soluble as well as insoluble compounds as particulate in air. Apparently, the particle size of the beryllium dust is a critical factor with regard to its potential for causing berylliosis (ref. 41). The lowest toxic concentration reported for humans is .1 mg/m^3 (ref. 2).

The LD_{50} (oral, rat) for $BeCl_2$ is 86 mg/kg or 9.7 mg/kg as beryllium.

Beryllium and five beryllium compounds are reported to cause cancer in animals. The EPA/NIOSH ordering number for beryllium and its compounds collectively is 6429. The lowest dose producing a carcinogenic response is 35 $\mu g/m^3$ as $BeSO_4 \cdot 4H_2O$ inhaled by a monkey for 24 hrs (ref. 2,46). This corresponds to a maximum absorption of 0.4 $\mu g/kg$ as Be assuming respiratory volume of 0.844 ℓ/min and the weight of the monkey as 5 kg (ref. 2, 3). The adjusted ordering number is 16,072,500.

Toxicity to fish: 96 hr. LC_{50} for the fathead minnow is 0.15 mg/ℓ as $BeCl_2$ in soft water (ref. 28).

Beryllium has been reported to be concentrated 1,000 times in marine organisms (ref. 33).

Beryllium is phytotoxic, inhibiting photosynthesis in plants. In nutrient solutions, 0.5 mg/ℓ of beryllium reduced growth of bush beans (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

Beryllium is the subject of a NIOSH Criteria Document. NIOSH recommends that occupational exposure to beryllium and its compounds not exceed 2 $\mu g/m^3$ as a time-weighted average for an 8-hour workday. A ceiling of 25 $\mu g/m^3$ is recommended (ref. 102).

TLV = 0.002 mg/m^3. Beryllium is classified by ACGIH as an "Occupational Substance Suspect of Oncogenic Potential for Workers," based on limited epidemiological evidence and demonstration of benign or malignant growths in test animals.

National Emission Standard for Hazardous Air Pollutants: Not more than 10 grams in 24 hrs or emissions which result in maximum outplant concentration of 0.01 $\mu g/m^3$, 30-day average (ref. 16).
Candidate for list for Toxic Effluent Standards (ref. 10).

On EPA Consent Decree Priority I List.

EPA 1976 Water Quality Criteria (proposed): 11 $\mu g/\ell$ for the protection of aquatic life in soft fresh water; 1,100 $\mu g/\ell$ for the protection of aquatic life in hard fresh water; 100 $\mu g/\ell$ for continuous irrigation on all soils (ref. 33).

NAS/NAE 1972 Water Quality Criteria recommendation for marine aquatic life: Hazard level--1.5 mg/ℓ; Minimal risk of deleterious effects--0.1 mg/ℓ; Application factor: 0.01 (applied to 96-hr LC_{50}). Recommendation for irrigation water: 0.10 mg/ℓ for continuous use on all soils (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2 $\mu g/m^3$

Water, Health: $15 \times 2 = 30$ $\mu g/\ell$

Land, Health: $0.002 \times 30 = 0.06$ $\mu g/g$

Air, Ecology:

Water, Ecology: $5 \times 11 = 55$ $\mu g/\ell$

Land, Ecology: $0.002 \times 55 = 0.11$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 9.7 = 1$ $\mu g/m^3$

$EPC_{AH3} = 0.081 \times 9.7 = 0.8$ $\mu g/m^3$

$EPC_{WH1} = 15 \times 0.8 = 12$ $\mu g/\ell$

$EPC_{WH2} = 0.4 \times 9.7 = 4$ $\mu g/\ell$

$EPC_{LH} = 0.002 \times 4 = 0.008$ $\mu g/g$

$EPC_{AC1} = 2/420 = 0.005$ $\mu g/m^3$

$EPC_{AC2} = 10^3/(6 \times 16{,}000{,}000) = 1 \times 10^{-5}$ $\mu g/m^3$

$EPC_{WC} = 15 \times 0.005 = 0.075$ $\mu g/\ell$

$EPC_{LC} = 0.002 \times 0.075 = 0.00015$ $\mu g/g$

$EPC_{WES} = 11$ $\mu g/\ell$

$EPC_{LE} = 0.002 \times 11 = 0.02$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.0E0		0.01		1.3×10^{-4} – 4.2×10^{-5}
Water, $\mu g/l$ (ppm Wt)			3.0E1	5.5E1	0.075	11	0.19, 6×10^{-4}†
Land, $\mu g/g$ (ppm Wt)			6.0E-2	1.1E-1	1.5E-4	0.02	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)	0.01				
Water, $\mu g/l$ (ppm Wt)		11	4		0.075
Land, $\mu g/g$ (ppm Wt)			0.008	0.02	0.00015

†For seawater.

CATEGORY: 33

WLN: MG

MAGNESIUM AND MAGNESIUM COMPOUNDS (AS MAGNESIUM): Mg.

A silvery metal of the alkaline-earth metal group.

STRUCTURE:

Mg Mg^{+2}

PROPERTIES:

Atomic number: 12, group 2a: atomic wt: 24.305;
mp: 651; bp: 1,120; d: 1.74; vap. press: 1 mm at 621° C;
valency: +2; reacts with water to produce H_2.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Rural background concentration in air is 1.4 to 800 $\mu g/m^3$ (ref. 1).

Natural concentration of seawater is 1.3×10^6 $\mu g/\ell$ (ref. 28). Magnesium carbonate, chloride, and sulfate are water soluble.

Magnesium is one of the most common elements of the Earth's crust--2.1 percent by weight (ref. 24).

In U.S. surface waters, magnesium composition averages 14.3 mg/ℓ with a range of 8.5 to 137 mg/ℓ (ref. 28).

Magnesium-bearing minerals include magnesite ($MgCO_3$), brucite ($Mg\,O \cdot H_2O$), and dolomite ($MgCO_3 \cdot CaCO_3$) (ref. 96).

TOXIC PROPERTIES, HEALTH EFFECTS:

Concentration of calcium and magnesium in water influences the toxicity of heavy metals (ref. 69).

The toxicity of magnesium compounds is usually that of the anion. Metallic magnesium may cause local skin effects (ref. 9). Inhalation of magnesium dust can cause metal fume fever (ref. 24).

LD_{LO} (oral, dog): 230 mg/kg.

At 7.2 ppm, magnesium inhibits the growth of *Botryococcus* (ref. 28).

24-hour LC_{50}: 3,391 ppm for *Daphnia magna* as $MgCl_2$ (ref. 28). This is equivalent to 866 ppm as Mg^{+2}.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (Magnesium Oxide fume): 10 mg/m^3, MgO M.W. = 40.3.; (as Mg): $24.3/40.3 \times 10 = 6$ mg/m^3 (based on TLV for MgO fume).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 6×10^3 $\mu g/m^3$
Water, Health: $15 \times 6 \times 10^3 = 9 \times 10^4$ $\mu g/\ell$
Land, Health: $0.002 \times 9 \times 10^4 = 180$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 866 = 8.7 \times 10^4$ $\mu g/\ell$
Land, Ecology: $0.002 \times 8.7 \times 10^4 = 174$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 6/420 = 14$ $\mu g/m^3$
$EPC_{WH1} = 15 \times 14 = 210$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 6 = 83$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 83 = 0.2$ $\mu g/g$

$EPC_{WE1} = 50 \times 866 = 43{,}300$ $\mu g/\ell$
$EPC_{LE} = 0.002 \times 43{,}300 = 87$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			6.0E3		14		1.4-800
Water, μg/l (ppm Wt)			9.0E4	8.7E4	83	43,300	14,300, 1.3×10^6†
Land, μg/g (ppm Wt)			1.8E2	1.74E2	0.2	87	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			14		
Water, μg/l (ppm Wt)			83	43,300	
Land, μg/g (ppm Wt)			0.2	87	

†For seawater.

CATEGORY: 33

MAGNESIUM OXIDE: MgO.

White powder.

WLN:

STRUCTURE:

MgO

PROPERTIES:

Molecular wt: 40.31; mp: 2,500-2,800; d: 3.65-3.75; solubility in water: 6.2 mg/ℓ at 20°, 86 mg/ℓ at 30°.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

MgO is primarily an air contaminant. Particle densities for MgO agglomerates are 3.65 g/cm^3 for normal and 0.35 g/cm^3 for floc (ref. 3).

TOXIC PROPERTIES, HEALTH EFFECTS:

Toxic effects are similar to but less marked than those caused by zinc oxide; fever and blood effects are caused by exposure. MgO dust is considered a mild hazard (ref. 4).

TC_{Lo} (inhalation, human): 400 mg/m^3 produced unspecified toxic effects.

Aquatic toxicity: TLm 96: over 1,000 ppm.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 10 mg/m^3.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.0×10^4 μg/m^3

Water, Health: $15 \times 1.0 \times 10^4 = 1.5 \times 10^5$ μg/ℓ

Land, Health: $0.002 \times 1.5 \times 10^5 = 300$ μg/g

Air, Ecology:

Water, Ecology: $100 \times 1{,}000 = 1.0 \times 10^5$ μg/ℓ

Land, Ecology: $0.002 \times 1.0 \times 10^5 = 200$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 10/420 = 24$ μg/m^3

$EPC_{WH1} = 15 \times 24 = 360$ μg/ℓ

$EPC_{WH2} = 13.8 \times 10 = 138$ μg/ℓ

$EPC_{LH} = 0.002 \times 138 = 0.3$ μg/g

$EPC_{WE1} = 50 \times 1{,}000 = 50{,}000$ μg/ℓ

$EPC_{LE} = 0.002 \times 50{,}000 = 100$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E4		24		
Water, $\mu g/l$ (ppm Wt)			1.5E5	1.0E5	138	50,000	
Land, $\mu g/g$ (ppm Wt)			3.0E2	2.0E2	0.3	100	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			24		
Water, $\mu g/l$ (ppm Wt)			138	50,000	
Land, $\mu g/g$ (ppm Wt)			0.3	100	

CATEGORY: 35

WLN:

STRONTIUM AND STRONTIUM COMPOUNDS (AS STRONTIUM): Sr.

A hard, silvery-white, ductile and malleable metal; a member of the alkaline earth group.

STRUCTURE:

Sr Sr^{++}

PROPERTIES:

Atomic number: 38; group 2a; atomic wt: 87.63; mp: 769;
bp: 1,384; d: 2.54; vap. press: 10 mm at 898° C; valency: +2; decomposes water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

The physical and chemical properties of strontium are intermediate between those of calcium and barium. It is a reactive metal; it oxidizes readily in air and reacts vigorously in water forming the hydroxide and evolving H_2. Strontium forms only divalent compounds. The artificial isotopes Sr^{89} and Sr^{90} occur as constituents of radioactive fallout from nuclear explosions.

The concentration of strontium in rural atmosphere is reported as 0.023 $\mu g/m^3$ (ref. 1).

Strontium occurs primarily as the minerals celestite ($SrSO_4$) and strontiantite ($SrCO_3$) (ref. 96).

TOXIC PROPERTIES, HEALTH EFFECTS:

Strontium has not been identified as an essential trace element in either plant or animal metabolism. It resembles calcium in its metabolism and behavior in the body. The naturally occurring isotopes are not highly toxic (ref. 98).

LD_{Lo} (intravenous, rat) for $SrCl_2$: 123 mg/kg; molecular wt $SrCl_2$: 158.5.

LD_{Lo} (as Sr): 87.6/158.5 x 123 = 68 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 45 x 68 = 3,060 $\mu g/m^3$
Water, Health: 15 x 3,060 = 46,000 $\mu g/\ell$
Land, Health: 0.002 x 46,000 = 92 $\mu g/g$

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH2} = 0.107 x 68 = 7.3 $\mu g/m^3$
EPC_{AH3} = 0.081 x 68 = 5.5 $\mu g/m^3$
EPC_{WH1} = 15 x 5.5 = 83 $\mu g/\ell$
EPC_{WH2} = 0.4 x 68 = 27 $\mu g/\ell$
EPC_{LH} = 0.002 x 27 = 0.05 $\mu g/g$

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			3.0E3		5.5		0.023
Water, $\mu g/l$ (ppm Wt)			4.6E4		27		
Land, $\mu g/g$ (ppm Wt)			9.2E1		0.05		

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			5.5		
Water, $\mu g/l$ (ppm Wt)			27		
Land, $\mu g/g$ (ppm Wt)			0.05		

CATEGORY: 36

WLN: BA

BARIUM AND BARIUM COMPOUNDS (AS BARIUM): Ba.

A white, soft metal.

STRUCTURE:

Ba Ba^{+2}

PROPERTIES:

Atomic number 56, an element of the calcium family group 2a;
Atomic wt: 137.34; mp: 752; bp: 1,600; d: 3.51^{20};
valency: +2; reacts with water; evolves H_2.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Rural background concentration in air is measured as zero (ref. 1).

Soluble barium compounds include the acetate, halides, hydroxide, thiocyanate, and thiosulfate.

Concentration in freshwater as indicated from hydrologic benchmark samples ranged from 0-500 μg/ℓ; out of 22 samples, 15 were zero (ref. 64).

In samples of surface waters in the United States, the barium concentration ranged from 2-340 μg/ℓ with a mean of 43 μg/ℓ (ref. 28).

Natural concentration of seawater is 20 μg/ℓ (ref. 28).

Essentially no food contains barium in appreciable amounts (ref. 28).

Occurrence in the Earth's crust is 0.05 percent by weight (ref. 24). It is found in nature only in combination with other elements; the two main minerals are barite ($BaSO_4$) and witherite ($BaCO_3$) (ref. 101). Trace quantities of barium are also found in coal (ref. 101).

TOXIC PROPERTIES, HEALTH EFFECTS:

Soluble barium compounds are highly toxic when ingested, while insoluble compounds are generally nontoxic (ref. 101).

The fatal dose of $BaCl_2$ for man is 0.8-0.9 g (0.55-0.6 g as Ba) (ref. 96). Barium stimulates all muscle types, causes vasoconstriction, and initially stimulates and then paralyzes the central nervous system. BaO and $BaCO_3$ have caused respiratory injury in man (ref. 96). Barium is readily excreted, and probably noncumulative (ref. 33).

LD_{Lo} (oral, rat): 335 mg/kg as $BaCl_2$ (or 220 mg/kg as Ba).

Teratogenic effects--Barium: 20 mg of $BaCl_2$ injected into chick yolk sac resulted in curled toes in about 50 percent of the survivors (ref. 32). The NIOSH ordering number is 1101. TD_{Lo} (as Ba) = 878 mg/kg (assuming wt. of 15 grams for chick). The adjusted ordering number = 1101/878 = 1.25.

Toxicity to aquatic life: LC_{50} for *Planorbis glabratus* (snail) is reported as 11 ppm, time unspecified (ref. 28); 500 ppm barium nitrate (as Ba) is toxic to Stickleback (ref. 36). Barium can be concentrated in goldfish by a factor of 150 (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (soluble compounds): 0.5 mg/m^3.

EPA 1976 Water Quality Criteria (proposed): 1 mg/ℓ for domestic water supply (health) (ref. 33); 1 mg/ℓ for drinking water is also specified in National Interim Primary Drinking Water Standards (ref. 102), Public Health Service Drinking Water Standards, 1962--Levels for Source Rejection (ref. 102), and NAS/NAE Water Quality Criteria, 1972 (ref. 28).

NAS/NAE recommendation for marine aquatic life: application factor--0.05 (to be applied to 96 hr LC_{50}); hazard level--1 mg/ℓ; minimal risk of deleterious effects--0.5 mg/ℓ (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 500 μg/m^3
Water, Health: 5 x 1,000 = 5,000 μg/ℓ
Land, Health: 0.002 x 5,000 = 10 μg/g

Air, Ecology:
Water, Ecology: 5 x 500 = 2,500 μg/ℓ
Land, Ecology: 0.002 x 2,500 = 5 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.5/420 = 1$ μg/m^3
$EPC_{WH1} = 15 \times 1 = 15$ μg/ℓ
$EPC_{WH2} = 13.8 \times 0.5 = 7$ μg/ℓ
$EPC_{WHS} = 1{,}000$ μg/ℓ
$EPC_{LH} = 0.002 \times 1{,}000 = 2$ μg/g

$EPC_{WES} = 500$ μg/ℓ
$EPC_{LE} = 0.002 \times 500 = 1$ μg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			5.0E2		1		0
Water, μg/l (ppm Wt)			5.0E3	2.5E3	1,000	500	43, 20†
Land, μg/g (ppm Wt)			1.0E1	5.0E0	2	1	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			1		
Water, μg/l (ppm Wt)	1,000	500			
Land, μg/g (ppm Wt)			2	1	

†For seawater.

CATEGORY: 37

WLN: B

BOROn AND BORON COMPOUNDS (AS BORON): B.

Monoclinic crystals, yellow or brown amorphous powder.

STRUCTURE:

B B^{+3}

PROPERTIES:

Atomic number: 5; group 3a; atomic wt: 10.81; mp: 2,300; bp: 2,550 (sublimes); d: 2.34; valency: +3; insoluble; vap. press at 2,413°K: 1.56×10^{-5} atm.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Natural concentration in seawater is 4.5 mg/ℓ (ref. 28). Natural concentration in freshwater averages 0.1 mg/ℓ, with a maximum of 5.0 mg/ℓ reported (ref. 33). Occurrence in the Earth's crust, in compound forms, is about 0.001 percent (ref. 24). Boron occurs in nature as the minerals borax (sodium borate) and colemanite (calcium borate) (ref. 28). Boron is a known constituent of coals; it has been found in ash from selected U.S. coals (ref. 103).

TOXIC PROPERTIES, HEALTH EFFECTS:

Boron is not a highly toxic element. It does not accumulate significantly in body tissues (ref. 28). Serious effects to humans are not reported for reasonable exposures.

LD_{50} (oral, mouse): 2,000 mg/kg.

Aquatic toxicity: Boron is mildly toxic to fish. The 96-hr LC_{50} for *Gambusia affinis* (topminnow) is reported as 3,600 mg/ℓ for sodium borate (ref. 28). There is no evidence that boron is cumulative.

Phytotoxicity: Sensitive crops such as citrus show toxic effects from 0.5 to 0.75 mg/ℓ of boron in irrigation water (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (Boron Oxide, B_2O_3): 10 mg/m^3, MW B_2O_3 = 69.6; (as Boron): 21.6/69.6 x 10 = 3.10 mg/m^3.

Report of the Committee on Water Quality Criteria, 1968, recommended a limit of 1 mg/ℓ in drinking water. A later Committee determined the limit was unnecessary (ref. 28).

NAS/NAE Water Quality Criteria, 1972: Recommendation for marine aquatic life--application factor--0.1 (to be applied to 96-hr LC_{50}); hazard level-- > 5.0 mg/ℓ; minimal risk of deleterious effects-- < 5.0 mg/ℓ. Recommendation for livestock waters--5.0 mg/ℓ. Recommendation for irrigation water--0.75 mg/ℓ for use on sensitive crops on all soils; 1 mg/ℓ for semitolerant crops; 2 mg/ℓ for tolerant crops (ref. 28).

EPA Water Quality Criteria, 1976 (proposed): 750 µg/ℓ for long-term irrigation on sensitive crops (ref. 33).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 3.1×10^3 µg/m^3

Water, Health: $15 \times 3.1 \times 10^3 = 4.7 \times 10^4$ µg/ℓ

Land, Health: $0.002 \times 4.7 \times 10^4 = 93$ µg/g

Air, Ecology:

Water, Ecology: $5 \times 5 \times 10^3 = 2.5 \times 10^4$ µg/ℓ

Land, Ecology: $0.002 \times 2.5 \times 10^4 = 50$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 3.1/420 = 7.4$ µg/m^3

$EPC_{WH1} = 15 \times 7.4 = 111$ µg/ℓ

$EPC_{WH2} = 13.8 \times 3.1 = 43$ µg/ℓ

$EPC_{LH} = 0.002 \times 43 = 0.09$ µg/g

$EPC_{WES} = 5{,}000$ µg/ℓ

$EPC_{LE} = 0.002 \times 5{,}000 = 10$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m^3 (ppm Vol)			3.1E3		74		
Water, μg/l (ppm Wt)			4.7E4	2.5E4	43	5,000	100, 4,500†
Land, μg/g (ppm Wt)			9.3E1	5.0E1	0.09	10	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m^3 (ppm Vol)			7.4		
Water, μg/l (ppm Wt)		5,000	43		
Land, μg/g (ppm Wt)			0.09	10	

†For seawater.

CATEGORY: 37

WLN:

STRUCTURE:

B_2O_3

BORON OXIDE: B_2O_3 (boric anhydride, boron sesquioxide, boron trioxide, fused boric acid, boric acid glass). Rhombic crystals or colorless vitreous material.

PROPERTIES:

Molecular wt: 69.6; mp: 460; bp: 1,860; d: 2.46 ± 0.01; soluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Boron oxide may occur in atmosphere as particulate matter or aerosols.

TOXIC PROPERTIES, HEALTH EFFECTS:

Boron oxide is not considered highly toxic (ref. 4).

TD_{Lo} (inhalation, rat): 470 mg/m^3 produced mild nasal irritation.

TL_{Lo} (inhalation, dog): 57 mg/m^3 produced increased urine volume and acidity, and increased creatinine coefficient (ref. 4).

See also Boron and Boron Compounds as Boron.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 10 mg/m^3.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.0×10^4 µg/m^3

Water, Health: $15 \times 1.0 \times 10^4 = 1.5 \times 10^5$ µg/ℓ

Land, Health: $0.002 \times 1.5 \times 10^5 = 300$ µg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 10/420 = 24$ µg/m^3

$EPC_{WH1} = 15 \times 24 = 360$ µg/ℓ

$EPC_{WH2} = 13.8 \times 10 = 138$ µg/ℓ

$EPC_{LH} = 0.002 \times 138 = 0.3$ µg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.0E4		24		
Water, μg/l (ppm Wt)			1.5E5		138		
Land, μg/g (ppm Wt)			3.0E2		0.3		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			24		
Water, μg/l (ppm Wt)			138		
Land, μg/g (ppm Wt)			0.3		

CATEGORY: 38

WLN: AL

ALUMINUM AND ALUMINUM COMPOUNDS (AS ALUMINUM), Al.

A silver-white, light, ductile metal; an earth metal.

STRUCTURE:

Al Al^{+3}

PROPERTIES:

Atomic number 13; group: 3a, atomic wt: 26.98; mp: 660.2; bp: 2467; d: 2.702; valency: +3; insoluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Aluminum is readily oxidized and covered with a film of Al_2O_3. It is soluble in acid or alkali. Aluminum forms one series of compounds; the aluminum ion is Al^{+3}. Many aluminum compounds are water soluble.

Rural concentration of aluminum in air is reported as 800 ng/m^3 to 43 μg/m^3 (ref. 1). This is equivalent to 0.8 to 43 μg/m^3.

The natural concentration of aluminum in seawater is 10 μg/ℓ (ref. 28).

Soluble aluminum is reported in U.S. surface waters as high as 3 mg/ℓ , but this is a rare occurrence (ref. 28).

Most edible grasses contain about 15-20 mg/kg of aluminum (ref. 28).

At 8.8 percent by weight, aluminum is one of the most abundant elements in the earth's crust (ref. 24).

Aluminum occurs as the minerals bauxite ($Al_2O_3 \cdot H_2O$), cryolite ($3NaF \cdot AlF_3$), spinel ($MgO \cdot Al_2O_3$) and feldspars such as orthoclase ($K_2O \cdot Al_2O_3 \cdot 6SiO_2$) and micas such as muscovite ($K_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2H_2O$) (ref. 96).

TOXIC PROPERTIES, HEALTH EFFECTS:

Although aluminum is not highly toxic element, large quantities may produce deleterious effects, such as pulmonary fibrosis from inhalation of aluminum powder (ref. 9). A level of 4,000 mg/kg in diet caused phosphorous deficiency in chicks (ref. 28).

Aquatic toxicity: a concentration of 0.07 mg/ℓ aluminum nitrate, as Al, is toxic to stickleback [Gasterosteus aculeatus] (ref. 28).

Aluminum is reported to be concentrated 10,000 times in fish muscle, and 15,000 times in benthic algae (ref. 28).

Aluminum compounds may adversely affect benthic organisms (e.g. clams, crabs, oysters, lobsters) (ref. 28).

High concentrations of aluminum in soils with low pH causes restricted root growth in plants (ref. 104).

Growth reductions in wheat and orange seedlings were reported in nutrient solutions with 0.1mg/ℓ of aluminum (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (Al_2O_3): 10 mg/m^3; molecular wt (Al_2O_3): 101.96

Based on TLV for Al_2O_3 as Al: 5.3 mg/m^3.

NAS/NAE Water Quality Criteria, 1972 - Recommendation for marine aquatic life: application factor--0.01 (to be applied to 96 hr LC_{50}); hazard level--1.5 mg/ℓ ; Minimal risk of deleterious effects -- 0.2 mg/ℓ . Recommendation for protection of livestock: 5 mg/ℓ . Recommendation for irrigation water: 5.0 mg/ℓ for continuous use on all soils (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 5.2×10^3 μg/m^3

Water, Health: $15 \times 5.3 \times 10^3 = 8 \times 10^4$ μg/ℓ

Land, Health: $0.002 \times 8 \times 10^4 = 160$ μg/g

Air, Ecology:

Water, Ecology: $5 \times 200 = 1,000$ μg/ℓ

Land, Ecology: $0.002 \times 1,000 = 2$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 5.3/420 = 12.6$ μg/ℓ

$EPC_{WH1} = 15 \times 12.6 = 190$ μg/ℓ

$EPC_{WH2} = 13.8 \times 5.3 = 73$ μg/ℓ

$EPC_{LH} = 0.002 \times 73 = 0.15$ μg/g

$EPC_{WES} = 200$ μg/ℓ

$EPC_{LE} = 0.002 \times 200 = 0.4$ μg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			5.2E3		12.6		
Water, μg/l (ppm Wt)			8.0E4	1.0E3	73	200	
Land, μg/g (ppm Wt)			1.6E2	2.0E0	0.15	0.4	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			12.6		
Water, μg/l (ppm Wt)		200	73		
Land, μg/g (ppm Wt)			0.15	0.4	

CATEGORY: 38

WLN: AL2.03

STRUCTURE:

Al_2O_3

ALUMINUM OXIDE: Al_2O_3 (alundum, alumina, corundum).
White powder or colorless hexagons.

PROPERTIES:

Molecular wt: 102; mp: 2020; bp: 2977; d: 3.75;
insoluble; % Aluminum: 53; vap. press: 1 mm at 2,158° C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Aluminum oxide is present as particulate matter in the atmosphere. Particle densities for aluminum oxide agglomerates are 3.75 g/cm^3 for normal and 1.18 g/cm^3 for floc (ref. 3).

TOXIC PROPERTIES, HEALTH EFFECTS:

There is no firm evidence of pneumoconiosis resulting from exposure to aluminum oxide (ref. 4). It is considered to be a nuisance particulate.

See also Aluminum and Aluminum Compounds, as Aluminum.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 10 mg/m^3; classified as nuisance particulate by ACGIH.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.0×10^4 μg/m^3
Water, Health: $15 \times 1.0 \times 10^4 = 1.5 \times 10^5$ μg/ℓ
Land, Health: $0.002 \times 1.5 \times 10^5 = 300$ μg/g

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 10/420 = 24$ μg/m^3
$EPC_{WH1} = 15 \times 24 = 360$ μg/ℓ
$EPC_{WH2} = 13.8 \times 10 = 138$ μg/ℓ
$EPC_{LH} = 0.002 \times 138 = 0.3$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E4		24		
Water, $\mu g/l$ (ppm Wt)			1.5E5		138		
Land, $\mu g/g$ (ppm Wt)			3.0E2		0.3		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			24		
Water, $\mu g/l$ (ppm Wt)			138		
Land, $\mu g/g$ (ppm Wt)			0.3		

CATEGORY: 39

WLN: GA

GALLIUM AND GALLIUM COMPOUNDS (AS GALLIUM): Ga

A grayish, metallic element.

STRUCTURE:

Ga Ga^{+3} Ga^{+1}

PROPERTIES:

Atomic number: 31; group 3a; atomic wt: 69.72; mp: 29.78; bp: 2,403; d: solid $5.904^{29.6}$, liquid $6.095^{29.8}$; valence: +2, +3; insoluble; vap. press: 0.004 mm at 1,000°C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Gallium is a close analog of aluminum. It forms gallous (+1) and gallic (+3) compounds, the +3 valence being more stable. It forms alums of the general formula MGa $(SO_4)_2 \cdot 12H_2O$. (M is a monovalent metal.) Many gallium compounds hydrolyze in water to form a hydrated gallium oxide.

Gallium suboxide, formed by reduction of the sesquioxide, is volatile.

Gallium is not present in significant amounts in seawater or in other natural waters (ref. 98).

Occurrence in the Earth's crust is 5×10^{-4} percent (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

In humans, gallium has caused metallic taste, skin rashes, and bone marrow depression (ref. 24). LD_{Lo} (subcutaneous, rat): 110 mg/kg for gallium.

Gallium compounds generally have a low order of toxicity. Intravenous injections up to 15 mg/kg body weight are tolerated without harm by experimental animals; however, larger doses produce hemorrhagic nephritis (ref. 24). Gallium is slowly eliminated from the body of animals after injection of soluble gallium salts. It is similar to the tissue distribution of bismuth and mercury in the body (ref. 24).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 110 = 4,950$ μg/m^3

Water, Health: $15 \times 4,950 = 7.4 \times 10^4$ μg/ℓ

Land, Health: $0.002 \times 7.4 \times 10^4 = 150$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 110 = 12$ μg/m^3

$EPC_{AH3} = 0.081 \times 110 = 9$ μg/m^3

$EPC_{WH1} = 15 \times 9 = 135$ μg/ℓ

$EPC_{WH2} = 0.4 \times 110 = 44$ μg/ℓ

$EPC_{LH} = 0.002 \times 44 = 0.09$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.0E3		9		
Water, $\mu g/l$ (ppm Wt)			7.4E4		44		0†
Land, $\mu g/g$ (ppm Wt)			1.5E2		0.09		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			9		
Water, $\mu g/l$ (ppm Wt)			44		
Land, $\mu g/g$ (ppm Wt)			0.09		

†Fresh and marine waters.

CATEGORY: 41

WLN: TL

THALLIUM AND THALLIUM COMPOUNDS (AS THALLIUM): Tl.

A rare element of the gallium/indium family. A bluish-white very soft metal.

STRUCTURE:

Tl $\underline{Tl^{+}}$ Tl^{+3}

PROPERTIES:

Atomic Number: 81; group: 3a; atomic wt.: 204.37; mp: 303.5; bp: 1,460; d: 11.862; valence +1, +3; insoluble; vap. press: 1 mm at 825°C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Thallium is the lightest element having naturally occurring radioactive isotopes. Thallous (valence +1) and thallic (+3) compounds are formed. Thallous compounds are more common; the carbonate, chloride, nitrate, and phosphate are water soluble. Concentration in natural seawater is 0.1 μg/ℓ (ref. 28).

Concentration in the Earth's crust is 0.7 ppm (ref. 24). Igneous rocks are estimated to contain 30 g thallium/ton (ref. 96).

TOXIC PROPERTIES, HEALTH EFFECTS:

Thallium and thallic compounds are extremely toxic by all routes of intake, causing both acute and chronic poisoning. Symptoms of poisoning include loss of hair, abdominal pain, pains in legs, neurological abnormalities, mental retardation, and psychoses (ref. 4). Toxicity is largely independent of valence state (ref. 96). The salts are cumulative salts analogous to lead.

LD_{50} (oral, rat): 23 mg/kg for thallium carbonate. This is equivalent to 20 mg/kg, as Tl.

There is no reported evidence in the references cited to indicate that thallium or its compounds are carcinogenic.

Toxicity to aquatic life: Concentrations of 2 to 4 mg/ℓ adversely affect Daphnia sp. (water flea)(ref. 28).

Thallium is reported to be phytotoxic for tobacco plants. It has been suggested that the phytotoxicity of thallium may be due to interference with potassium-dependent processes in light of the similar ionic radii. Ionic radius for potassium is 1.33Å, for thallium, 1.44Å (ref. 105).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

On EPA Consent Decree Priority I List.

TLV (soluble compounds) = 0.1 mg/m^3 (based largely on analogy with other highly toxic heavy metals).

Thallium is classified by ACGIH as an Industrial Substance Suspect of Carcinogenic Potential for Man.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 100 $\mu g/m^3$

Water, Health: 15 x 100 = 1,500 μg/ℓ

Land, Health: 0.002 x 1,500 = 3 μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.1/420 = 0.24\ \mu g/m^3$

$EPC_{WH1} = 15 \times 0.24 = 3.6\ \mu g/\ell$

$EPC_{WH2} = 13.8 \times 0.1 = 1.4\ \mu g/\ell$

$EPC_{LH} = 0.002 \times 1.4 = 0.003\ \mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E2		0.24		
Water, $\mu g/l$ (ppm Wt)			1.5E3		1.4		
Land, $\mu g/g$ (ppm Wt)			3.0E0		0.003		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.24		
Water, $\mu g/l$ (ppm Wt)			1.4		
Land, $\mu g/g$ (ppm Wt)			0.003		

CATEGORY: 42

WLN: CO

CARBON MONOXIDE: CO

A colorless, odorless gas.

STRUCTURE:

CO

PROPERTIES:

Molecular wt: 28.01; mp: -199; bp: -191.5; d: 1.250 g/ℓ at 0°; 1.15 g/ℓ at 25° (ref. 106); solubility: 3.5 cm^3/100 ml at 0°, 2.32 cm^3/100 ml at 20°.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Atmospheric concentrations of carbon monoxide are reported ranging 0.05 to 1.4 ppm, the average concentration being 0.3 ppm (refs. 1, 3). This is equivalent to 0.06 to 1.6 $\mu g/m^3$, averaging 0.3 $\mu g/m^3$. The density of CO is similar to that of air.

The National Air Quality Standards reference method for detection of CO utilizes nondispersive infrared spectrometry (ref. 3).

Carbon monoxide is a product of incomplete combustion of carbonaceous materials.

There is some evidence that certain soil fungi may convert carbon monoxide to carbon dioxide (ref. 106).

TOXIC PROPERTIES, HEALTH EFFECTS:

The effect of carbon monoxide on the body is asphyxiation. Carbon monoxide has an affinity for hemoglobin 200-250 times that of oxygen (ref. 106). Combination of CO with hemoglobin prevents O_2 from reaching tissues. Symptoms of poisoning occur when the CO-hemoglobin complex in blood exceeds 10 percent; concentrations of 80 percent are fatal (refs. 4, 9). A concentration of 400-500 ppm may be safely tolerated for 1 hr (ref. 9). However, exposure to 650 ppm for 45 min caused toxic effects for a man (ref. 2).

The biological half-life is reported as 2 hours (ref. 22). The degree of harm associated with exposure to carbon monoxide is a product of the concentration times the length of exposure. The following equations for estimating effects for exposures of a few hours are reported: hours x ppm = 300 (no perceptible effect); hours x ppm = 600 (just perceptible effect); hours x ppm = 900 (headache and nausea); hours x ppm = 1500 (dangerous to life) (ref. 107).

Effect on plants: Exposure to 500 ppm for 2 days produced epinasty in tomato petiole (ref. 3).

Carbon monoxide did not produce harmful effects on higher plant life at concentrations below 115 mg/m^3 (100 ppm) during exposures of 1-3 weeks on over 100 species (ref. 108).

Effect on aquatic life: Concentrations of <1/2 ml/ℓ or 0.6 mg/ℓ are toxic to various species of fish (ref. 36).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 55 mg/m^3 (50 ppm) (based on air concentrations which should result in blood levels not greater than 10 percent).

Carbon monoxide is the subject of a NIOSH Criteria Document. The NIOSH recommendation for occupational exposure is 35 ppm (40 mg/m^3) as an 8-hour worday time-weighted average. A ceiling concentration of 200 ppm is also recommended (ref. 109).

National Primary and Secondary Ambient Air Quality Standards: 8-hr averaging time--10 mg/m^3 (9 ppm); 1-hr averaging time--40 mg/m^3 (35 ppm) (ref. 110).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 4.0×10^4 $\mu g/m^3$ (35 ppm)

Water, Health: $15 \times 4.0 \times 10^4 = 6.0 \times 10^5$ $\mu g/\ell$

Land, Health:

Air, Ecology: 1.15×10^5 $\mu g/m^3$ (100 ppm)

Water, Ecology: $100 \times 0.6 = 60$ $\mu g/\ell$

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 40/420 = 95\ \mu g/m^3$

$EPC_{AH1a} = 35/420 = 0.08$ ppm

$EPC_{WH1} = 15 \times 95 = 1425\ \mu g/\ell$

$EPC_{WH2} = 13.8 \times 40 = 552\ \mu g/\ell$

$EPC_{AE} = 100 \times 115 = 11{,}500\ \mu g/m^3$

$EPC_{WE1} = 50 \times 0.6 = 30\ \mu g/\ell$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.0E4 (35)	1.2E5 (100)	10,000 (9)	10,000 (9)	0.3 (0.3)
Water, $\mu g/l$ (ppm Wt)			6.0E5	6.0E1	552	30	
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)	10,000 (9)	10,000 (9)			
Water, $\mu g/l$ (ppm Wt)			552	30	
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 42 **WLN:** OCO

CARBON DIOXIDE: CO_2 (carbonic acid gas, carbonic anhydride, dry ice).
A heavy odorless, colorless incombustible gas.

STRUCTURE:

CO_2

PROPERTIES:

Molecular wt: 44.01; mp: -56.6 at 5.2 atmos.; bp: -78.5 (sublimes); d: 1.977 g/ℓ at 0°; vap. d: 1.53; max solubility: 0.3356 g/100 ml at 0° C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Carbon dioxide generally comprises about 0.03 percent by volume of dry air or 300 ppm (ref. 3). This is equivalent to 539 mg/m^3. The concentration in the exhaled breath may be as high as 5.6 percent (ref. 107).

The solubility of CO_2 in water changes drastically with changes in water temperature. Concentrations of CO_2 in freshwater are generally below 5 mg/ℓ (ref. 28).

TOXIC PROPERTIES, HEALTH EFFECTS:

Except as a contributor to oxygen deficiency, carbon dioxide does not offer serious industrial exposures (ref. 107). Humans exposed to 50,000 ppm of CO_2 experience pronounced respiratory stimulation (ref. 4).

Teratogenic effects in rats and rabbits have been reported when the pregnant animals were exposed to 6 or 10 percent CO_2, respectively (refs. 32, 2). These effects may be due to oxygen deprivation.

Free CO_2 in water may adversely affect aquatic life, although it is not considered a major hazard. An effect called gas-bubble disease is produced in fish by excessive dissolved gases in water (ref. 33).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 9,000 mg/m^3 (5,000 ppm). Classified by ACGIH as a simple asphyxiant.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 9×10^6 μg/m^3 (5,000 ppm)
Water, Health:
Land, Health:

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH} = 539,000 μg/m^3 (300 ppm) (natural background).

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			9.0E6 (5,000)				539,000 (300)
Water, $\mu g/l$ (ppm Wt)							
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			539,000 (300)		
Water, $\mu g/l$ (ppm Wt)					
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 44

WLN: GE

GERMANIUM AND GERMANIUM COMPOUNDS (AS GERMANIUM): Ge.

A gray-white metalloid, crystalline and brittle.

STRUCTURE:

Ge Ge^{+2} Ge^{+4}

PROPERTIES:

Atomic number: 32; group 4a; atomic wt: 72.59; mp: 937.2; bp: 2,700; d: 5.36; valency: +2 or +4; insoluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Germanium, which is an element of the carbon family forms germanous (Ge^{+2}) and germanic (Ge^{+4}) compounds. Germanic compounds are generally more stable. Germanium hydride, GeH_4 (germane) is a colorless gas (see Toxic Properties).

Occurrence in the Earth's crust is about 0.0007 percent (ref. 24). Germanium is not found in the free state in nature, but always in combination with other elements (ref. 96). Some coals also contain germanium (ref. 96).

TOXIC PROPERTIES, HEALTH EFFECTS:

Germanium compounds are generally of a low order of toxicity. They are thought to resemble other organometals, which are usually more toxic than inorganic forms. Animal studies indicate that germanium after absorption is widely distributed throughout the body and is not selectively retained in any tissue (ref. 96). At high exposure levels germanium disturbs the water balance in mammals leading to dehydration, hemoconcentration, fall in blood pressure, and hypothermia (ref. 96).

Germanium hydride is considered moderately toxic, but can cause death of experimental animals at 150 ppm. It is similar to, but less toxic than, arsine and stibine and causes a hemolytic response (refs. 4,9).

Germanium dioxide stimulates generation of red blood cells (ref. 9).

LD_{Lo} (subcutaneous, rabbit): 586 mg/kg for germanium.

LD_{50} (intraperitoneal, rat): 750 mg/kg for germanium dioxide.

Germanium is taken up by cereals, especially oats, from Ge-bearing soils (ref. 96).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (Germanium Tetrahydride, GeH_4): 0.6 mg/m^3 (0.2 ppm). This is equivalent to 0.56 mg/m^3 as Ge.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 560 μg/m^3

Water, Health: 15 x 560 = 8,400 μg/ℓ

Land, Health: 0.002 x 8,400 = 17 μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.56/420 = 1.3$ μg/m^3

$EPC_{WH1} = 15 \times 1.3 = 20$ μg/ℓ

$EPC_{WH2} = 13.8 \times 0.56 = 8$ μg/ℓ

$EPC_{LH} = 0.002 \times 8 = 0.016$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.6E2		1.3		
Water, $\mu g/l$ (ppm Wt)			8.4E3		8		
Land, $\mu g/g$ (ppm Wt)			1.7E1		0.016		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			1.3		
Water, $\mu g/l$ (ppm Wt)			8		
Land, $\mu g/g$ (ppm Wt)			0.016		

CATEGORY: 46

LEAD AND LEAD COMPOUNDS (AS LEAD): Pb (Plumbum)

Bluish-gray, soft metal.

WLN: PB

STRUCTURE:

$Pb \quad Pb^{+2} \quad Pb^{+4}$

PROPERTIES:

Atomic Number 82; group 4a; atomic wt: 207.2; mp: 327.5; bp: 1,744; d: 11.3437^{16}; vap. press: 1 mm at 973°; valency: +2, +4; insoluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Lead forms divalent and tetravelent compounds. Rural background concentration in air is reported as 0.002 to 0.47 μg/m³ (refs. 1,93). Another source reports concentrations ranging 0.022 to 0.096 μg/m³ lead as a constituent of gross suspended particulates in non-urban air (ref. 3). Concentrations of lead in freshwater as measured in Hydrologic Benchmark samples range 0 to 50 μg/ℓ; 71 out of 108 samples were 0 (ref. 64). Natural concentration in seawater is reported as 0.02 μg/ℓ (ref. 28). The lead content of rural U.S. soils is reported as 10-15 μg/g (ref. 33). Occurrence in the earth's crust is 0.002 percent or 15 g/ton (ref. 24). The average adult total intake of lead has been estimated as 254 μg/day (ref. 113).

TOXIC PROPERTIES, HEALTH EFFECTS:

The compounds of lead are poisonous, usually in proportion to their solubility. The toxicity of particulate lead is dependent on the particle size. Ingested lead is largely captured by the liver and excreted in bile. Lead absorbed through inhalation results in toxic effects from smaller amounts. Lead poisoning results in hemolysis of red blood cells, lesions of the kidneys, liver, male gonads, nervous system, and blood vessels. Lead is a cumulative poison. The biological half-life is reported as 6 months (ref. 22). Cattle are resistant to lead toxicosis, but lead may accumulate in tissues or in milk in levels that could be toxic to man (ref. 28).

Several lead salts are reported to cause oncogenic effects in animals. The EPA/NIOSH ordering number considering the lead compounds collectively is 4214. The lowest dosage, as lead, to result in tumors in animals is 555 mg/kg. The adjusted ordering number is 7.6 (excluding lead chromate).

There is evidence that exposure to lead increases the incidence of abortion and stillbirths (ref. 32). It is known that lead is transferred across the human placenta. Exposure to lead has resulted in teratogenic effects in animals. The EPA/NIOSH ordering number based on teratogenicity considering lead compounds collectively is 4202. The lowest dosage reported to produce effects in offspring is 31 mg/kg. The adjusted ordering number is 136.

Aquatic toxicity: Reproductive impairment of *Daphnia magnia*, occurs at concentrations of 30 μg/ℓ (ref. 33).

Phytotoxicity: Normally >25 mg/ℓ of Pb in nutrient solutions is required to produce toxic effects in plants (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (inorganic fumes and dusts, as Pb): 0.15 mg/m³ (oncogenic or teratogenic potential not considered). Inorganic lead is the subject of a NIOSH Criteria Document; the NIOSH recommendation agrees with ACGIH TLV (ref. 111).

On EPA's Consent Decree Priority I List. Candidate for list for Toxic Pollutant Effluent Standards (ref. 10). Under study for designation under National Emission standards for Hazardous Air Pollutants (ref. 16).

National Interim Primary Drinking Water Regulations: 0.05 mg/ℓ (ref. 102).

U.S. Public Health Service Drinking Water Regulations, Levels for Source Rejection: 0.05 mg/ℓ (ref. 66).

EPA 1976 Water Quality Criteria (proposed): For domestic water supply (health)--50 μg/ℓ; for sensitive freshwater resident species--0.01 times 96-hour LC_{50} (ref. 33).

NAS/NAE 1972 Water Quality Criteria: For public water supply--0.05 mg/ℓ; for freshwater aquatic life--maximum concentrations of 0.03 mg/ℓ; for marine aquatic life--application factor of 0.01 (applied to 96-hour LC_{50}) as a 24-hour average; hazard level--0.05 mg/ℓ; minimal risk of deleterious effects--0.01 mg/ℓ; for livestock water--0.1 mg/ℓ; for irrigation--5.0 mg/ℓ for continuous use on all soils (ref. 28).

U.S. Department of Agriculture and Land Grant Institutions recommendations for soil concentrations: For most soils--1,000 kg/hectare (ref. 112).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 150 μg/m³	Air, Ecology:
Water, Health: 5 x 50 = 250 μg/ℓ	Water, Ecology: 5 x 10 = 50 μg/ℓ
Land, Health: 0.002 x 250 = 0.5 μg/g	Land, Ecology: 0.002 x 50 = 0.1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.15/420 = 0.36\ \mu g/m^3$

$EPC_{WH1} = 15 \times 0.36 = 5.4\ \mu g/\ell$

$EPC_{WH2} = 13.8 \times 0.15 = 2\ \mu g/\ell$

$EPC_{WHS} = 50\ \mu g/\ell$

$EPC_{LH} = 0.002 \times 50 = 0.1\ \mu g/g$

$EPC_{AC2} = 10^3/(6 \times 7.6) = 22\ \mu g/m^3$

$EPC_{WC} = 15 \times 22 = 330\ \mu g/\ell$

$EPC_{LC} = 0.002 \times 330 = 0.7\ \mu g/g$

$EPC_{WES} = 10\ \mu g/\ell$

$EPC_{LE} = 0.002 \times 10 = 0.02\ \mu g/g$

$EPC_{AT} = 10^3/(6 \times 136) = 1\ \mu g/m^3$

$EPC_{WT} = 15 \times 1 = 15\ \mu g/\ell$

$EPC_{LT} = 0.002 \times 15 = 0.03\ \mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m^3 (ppm Vol)			1.5E2		0.36		0.002-0.47
Water, μg/l (ppm Wt)			2.5E2	5.0E1	50	10	0-50 0.02†
Land, μg/g (ppm Wt)			5E-1	1E-1	0.01	0.02	10-15

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m^3 (ppm Vol)			0.36		1
Water, μg/l (ppm Wt)	50	10			
Land, μg/g (ppm Wt)			0.1	0.02	0.03

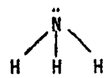
†For seawater.

CATEGORY: 47

WLN: ZH

AMMONIA: NH_3 (ammonia gas).
A colorless gas, extremely pungent odor.

STRUCTURE:



PROPERTIES:

Molecular wt: 17.03; mp: -77.7; bp: -33.35; d: 0.771; vap. press: 10 atm at 25.7° C; vap. d: 0.6; solubility in water: 90 g in 100 mℓ at 0°.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Urban air concentrations of ammonia are reported as 2-10 ppb (ref. 1). This is equivalent to 1.4 to 7 $\mu g/m^3$. The odor of ammonia is detectable at <5 ppm (ref. 99).

Ammonia is present in most waters as a normal biological degradation product of nitrogenous organic matter (ref. 33). Total ammonia in water consists of ionized (NH_4^+) and un-ionized (NH_3). The equilibrium between the two species is influenced by temperature, pH, and ionic strength. The NH_3 species is favored by increasing temperatures and increasing pH.

Ammonia is produced as a byproduct of coal-conversion processes.

TOXIC PROPERTIES, HEALTH EFFECTS:

Ammonia is primarily an irritant to eyes, mucous membranes, and upper respiratory tract. No chronic effects are reported from low-level exposure (refs. 4, 114). The lowest concentration reported to cause irritation in a human is 20 ppm via inhalation (ref. 2). Exposure to 10,000 ppm for 3 hours resulted in death for a human (ref. 2). The biological half-life for ammonia is reported as <20 minutes (ref. 22).

The LC_{50} (inhalation, rat) is 2,000 ppm for 4 hr.

Effects on plants--most sensitive species is mustard plant (refs. 114, 3); 4-hr exposure to 2,100 $\mu g/m^3$ resulted in marking of 15 percent of the leaf area (ref. 3).

Toxicity of ammonia to aquatic life is attributed to the un-ionized species, NH_3. TLm 96 ranges from 10-1 ppm (ref. 2). Levels of un-ionized ammonia >0.20 mg/ℓ have been shown to be toxic to some aquatic species (ref. 33). Ammonia consumes dissolved oxygen as a result of its biochemical oxidation to nitrite and nitrate (ref. 28). The presence of ammonia in water also increases the chlorine demand for the purpose of chemical disinfection.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 18 mg/m^3 (25 ppm).

Ammonia is the subject of a NIOSH criteria document. NIOSH recommends a ceiling concentration of 50 ppm as determined by a 5-minute sampling period for occupational exposure to ammonia (ref. 115).

Ammonia is listed in the Chemical Industry Institute of Toxicology Second Priority Chemicals List (ref. 11).

NAS/NAE 1972 Water Quality Criteria: For public water supply--0.5 mg/ℓ (ammonia nitrogen); for freshwater aquatic life--maximum concentration of 0.02 mg NH_3/ℓ; application factor of 0.05 (to be applied to 96-hr LC_{50}; for marine aquatic life--NH_3 hazard level: 0.4 mg/ℓ ; minimal risk of deleterious effects: 0.01 mg/ℓ; application factor of 0.1 (to be applied to 96-hr LC_{50}) (ref. 28).

EPA 1976 Water Quality Criteria (proposed): 0.02 mg/ℓ (as NH_3) for freshwater aquatic life (ref. 33).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.8×10^4 $\mu g/m^3$ (25 ppm)
Water, Health: $5 \times 500 = 2.5 \times 10^3$ $\mu g/ℓ$
Land, Health: $0.002 \times 2.5 \times 10^3 = 5$ $\mu g/g$

Air, Ecology: $4/24 \times 2,100 = 350$ $\mu g/m^3$
Water, Ecology: $5 \times 10 = 50$ $\mu g/ℓ$
Land, Ecology: $0.002 \times 50 = 0.1$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 18/420 = 43$ $\mu g/m^3$
$EPC_{AH1a} = 25/420 = 0.06$ ppm
$EPC_{WH1} = 15 \times 43 = 645$ $\mu g/ℓ$
$EPC_{WH2} = 13.8 \times 18 = 250$ $\mu g/ℓ$
$EPC_{WHS} = 500$ $\mu g/ℓ$
$EPC_{LH} = 0.002 \times 500 = 1$ $\mu g/g$

$EPC_{AE} = 0.1 \times 4/24 \times 2,100 = 35$ $\mu g/m^3$
$EPC_{WE1} = 50 \times 1 = 50$ $\mu g/ℓ$
$EPC_{WES} = 10$ $\mu g/ℓ$
$EPC_{LE} = 0.002 \times 10 = 0.02$ $\mu g/g$

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.8E4 (25)	3.5E2	43 (0.06)	35	1.4-7 †
Water, $\mu g/l$ (ppm Wt)			2.5E3	5.0E1	500	10	
Land, $\mu g/g$ (ppm Wt)			5.0E0	1.0E-1	1	0.02	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			43 (0.06)	35	
Water, $\mu g/l$ (ppm Wt)	500	10			
Land, $\mu g/g$ (ppm Wt)			1	0.02	

†Report for urban atmosphere

CATEGORY: 47

WLN: ZQ

HYDRAZINE: N_2H_4 (Diamide).

Colorless, oily hygroscopic liquid, fuming in air; penetrating odor resembling that of ammonia.

STRUCTURE:

$H_2N \quad NH_2$

PROPERTIES:

Molecular wt: 32.06; mp: 1.4; bp: 113.5; d: 1.008 g/cm^3 at 20°; vap. d: 1.11; vap. press: 14.4 mm at 25°; pK_{b1} = 5.52; miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Hydrazine is considered a hazardous chemical due to its instability toward heat or oxidizing agents. It is strongly basic (ref. 41). Hydrazine has been identified in the gas phase of tobacco (ref. 59). The median detectable concentration (irritation and/or odor) is 3 to 4 ppm for less than 1 minute (ref. 41).

TOXIC PROPERTIES, HEALTH EFFECTS:

Hydrazine is a powerful irritant and very toxic by ingestion, inhalation, or skin absorption (ref. 41). Absorption appears to be rapid and excretion or detoxication is slow (ref. 41).

It is considered to be a cumulative poison (ref. 47). Inhalation of high concentrations of hydrazine has resulted in damage to lungs, liver, and kidneys in experimental animals (refs. 4, 41); chronic exposure resulted in bone marrow depression, fatty livers, and an abnormal incidence of tumors (refs. 4, 2).

LD_{50} (oral, rat): 60 mg/kg.

LC_{50} (inhalation, rat): 570 ppm for 4 hours.

Hydrazine is reported to cause tumors in mice (refs. 4, 44) and in rats (ref. 44). The EPA/NIOSH ordering number is 4224. The lowest dosage resulting in a carcinogenic response is 400 mg/kg. The adjusted ordering number is 10.6.

Derivatives of hydrazine are reported to cause tumors in experimental animals (ref. 2) and have caused chromosome aberrations in mammalian cells (ref. 42).

Aquatic toxicity: Hydrazine is reported to be harmful to aquatic life in very low concentrations (ref. 116).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV: 1.3 mg/m^3 (1 ppm).

Intended change--TLV: 0.15 mg/m^3 (0.1 ppm) (ACGIH recognizes hydrazine as an industrial substance suspect of carcinogenic potential for man).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 150 μg/m^3 (0.1 ppm)

Water, Health: $15 \times 150 = 2.25 \times 10^3$ μg/ℓ

Land, Health: $0.002 \times 2.25 \times 10^3 = 4.5$ μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 1.3/420 = 3.1$ μg/m^3

$EPC_{AH1a} = 1/420 = 0.002$ ppm

$EPC_{WH1} = 15 \times 3.1 = 46.5$ μg/ℓ

$EPC_{WH2} = 13.8 \times 1.3 = 18$ μg/ℓ

$EPC_{LH} = 0.002 \times 18 = 0.04$ μg/g

$EPC_{AC1} = 10^3 \times 0.15/420 = 0.36$ μg/m^3

$EPC_{AC2} = 10^3/(6 \times 10.6) = 15.7$ μg/m^3

$EPC_{WC} = 15 \times 0.36 = 5.4$ μg/ℓ

$EPC_{LC} = 0.002 \times 5.4 = 0.01$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.5E2		0.36		
Water, $\mu g/l$ (ppm Wt)			2.3E3		5.4		
Land, $\mu g/g$ (ppm Wt)			4.5E0		0.01		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			3.1 (0.002)		0.36
Water, $\mu g/l$ (ppm Wt)			18		5.4
Land, $\mu g/g$ (ppm Wt)			0.04		0.01

CATEGORY: 47

HYDROGEN CYANIDE: HCN (hydrocyanic acid).
Colorless liquid with characteristic odor.

WLN:

STRUCTURE:

HCN

PROPERTIES:

Molecular wt: 27.03; mp: -13.4; bp: 25.7; vap. d: 0.94; vap. press: 807.23 mm at 27.22° C; miscible with water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Hydrogen cyanide is one of the commonly occurring forms of cyanide. The odor recognition level of HCN is 2 to 5 ppm (ref. 35).

In water, a significant fraction of the cyanide exists as HCN up to about pH8; the fraction increases as the pH decreases.

TOXIC PROPERTIES, HEALTH EFFECTS:

Cyanide inhibits oxygen metabolism (ref. 33) and is absorbed very rapidly by inhalation; the liquid and the vapor are absorbed through intact skin (ref. 35). At 0.3 mg/ℓ, HCN is immediately fatal to man; 0.02 to 0.04 mg/ℓ produces symptoms after several hours (ref. 35). There are reports of chronic as well as acute poisoning by HCN (ref. 4).

LD_{LO} (inhalation, rat): 0.12 mg/ℓ (ref. 35).

LD_{LO} (inhalation, dog): 0.07-0.04 mg/ℓ (ref. 35).

Hydrogen cyanide produced injury to orange trees at 1,100 ppm for 40 minutes (ref. 123). This is equivalent to 1,212 mg/m^3.

Aquatic toxicity: Cyanide is much more toxic to fish than to man (ref. 28). It is probably the most toxic form of cyanide in water (ref. 33). Cyanide is lethal to brook trout, Salvelinus fontinalis, at 50 μg/ℓ; at 10 μg/ℓ, swimming ability is affected (ref. 33).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV: 11 mg/m^3 (10 ppm)

Regulations and criteria pertinent to cyanide follow:

Cyanide appears on EPA's Consent Decree List, Priority 3. It has been designated for Toxic Pollutant Effluent Standards (ref. 10).

U.S. Public Health Service Drinking Water Regulation: Levels for Source Rejection--0.2 mg/ℓ; Levels for Alternate Source Selection--0.1 mg/ℓ cyanide (ref. 66).

NAS/NAE 1972 Water Quality Criteria: for public water supply sources--0.2 mg/ℓ cyanide; for freshwater aquatic life--maximum concentration of 0.005 mg/ℓ as CN-; application factor of 0.05 (to be applied to 96-hour LC_{50}); for marine aquatic life--hazard level: 0.01 mg/ℓ; minimal risk of deleterious effects: 0.005; application factor of 0.1 (to be applied to 96-hour LC_{50}) (ref. 28).

EPA 1976 Water Quality Criteria (proposed): 5.0 μg/ℓ for freshwater and marine aquatic life and wildlife (ref. 33).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.1×10^4 μg/m^3 (10 ppm)
Water, Health: 5 x 100 = 500 μg/ℓ
Land, Health: 0.002 x 500 = 1 μg/g

Air, Ecology: $1{,}212 \times 40/1{,}440 \times 10^3 = 3.4 \times 10^4$ μg/m^3
Water, Ecology: 5 x 5 = 25 μg/ℓ
Land, Ecology: 0.002 x 25 = 0.05 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 11/420 = 26$ μg/m^3
$EPC_{AH1a} = 10/420 = 0.024$ ppm
$EPC_{WH1} = 15 \times 26 = 390$ μg/ℓ
$EPC_{WH2} = 13.8 \times 11 = 152$ μg/ℓ
$EPC_{WHS} = 100$ μg/ℓ
$EPC_{LH} = 0.002 \times 100 = 0.2$ μg/g

$EPC_{AE} = 0.1 \times 1{,}212 \times 40/1{,}440 \times 10^3 = 3.4 \times 10^3$ μg/m^3
$EPC_{WE1} = 0.05 \times 50 = 2.5$ μg/ℓ
$EPC_{WES} = 5$ μg/ℓ
$EPC_{LE} = 0.002 \times 5 = 0.01$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.1E4	3.4E4	26 (0.024)	3,400	
Water, $\mu g/l$ (ppm Wt)			5.0E2	2.5E1	100	5	
Land, $\mu g/g$ (ppm Wt)			1.0E0	5.0E-2	0.2	0.01	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			26 (0.024)	3,400	
Water, $\mu g/l$ (ppm Wt)	100	5			
Land, $\mu g/g$ (ppm Wt)			0.2	0.01	

CATEGORY: 47

WLN: NC A0/2; NC NA; KA CN

ALKALI CYANIDES, AS CN-: (sodium cyanide, potassium cyanide)
White deliquescent powder, odor of bitter almonds.

STRUCTURE:

CN^-

NaCN

KCN

PROPERTIES:

NaCN--Molecular wt: 49.02; mp: 563.7; bp: 1,496; vap. press: 1 mm (817° C);
KCN--Molecular wt: 65.11; mp: 634.5; d: 1.52^{16}; soluble in water.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Cyanides occur in nature bound in the form of glycosides (i.e., amygdalin) in certain plants and seeds (ref. 24). The odor of alkali cyanides is due to the formation of HCN by the hydrolysis of the cyanide ion in water absorbed from air.

The alkali cyanides are readily soluble in water. When the simple salts dissociate in water, the CN- ion combines with the hydrogen ion to form hydrocyanic acid, HCN, or with heavy metals to form metallocyanide complexes (ref. 33). Physical and chemical conditions will determine the forms of cyanide eventually resulting from solutions of the alkali cyanide.

TOXIC PROPERTIES, HEALTH EFFECTS:

The alkali cyanides are acutely toxic by inhalation, skin absorption, and ingestion. They are among the most rapidly acting of all poisons (ref. 35). Cyanide toxicity is essentially an inhibition of oxygen metabolism (ref. 33). If chronic poisoning does occur, it is rare (ref. 35). Human ingestion of up to nearly 5 mg/day over a long term did not result in harmful effects (ref. 33). Alkali cyanides are more irritating than HCN as a result of the alkalinity (ref. 4). Ingestion of 2,857 µg/kg as NaCN has resulted in human death (ref. 2).

LD_{50} (oral, rat): 6,440 µg/kg. (for NaCN) , 10 mg/kg (for KCN).

Aquatic toxicity: Free cyanide concentrations from 0.05 to 0.01 mg/ℓ as CN have proved fatal to many sensitive fishes; the effective toxicant is generally HCN (ref. 28).

See also Hydrogen Cyanide.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV: 5 mg/m^3 (skin)

Cyanides appear on EPA's Consent Decree List, Priority 3. Cyanides are designated to be addressed by Toxic Pollutant Effluents Standards (ref. 10).

U.S. Public Health Service Drinking Water Regulations: Levels for Source Rejection--0.2 mg/ℓ; Levels for Alternate Source Selection--0.1 mg/ℓ cyanide (ref. 66).

NAS/NAE 1972 Water Quality Criteria: for public water supply sources--0.2 mg/ℓ cyanide; for freshwater aquatic life--maximum concentration of 0.005 mg/ℓ as CN-; application factor of 0.05 (to be applied to 96-hour LC_{50}); for marine aquatic life--hazard level: 0.01 mg/ℓ; minimal risk of deleterious effects: 0.005; application factor of 0.1 (to be applied to 96-hour LC_{50}) (ref. 28).

EPA 1976 Water Quality Criteria (proposed): 5.0 µg/ℓ for freshwater and marine aquatic life and wildlife (ref. 33).

MINIMUM ACUTE TOXICITY CONCENTRATIONS AS CN:

Air, Health: 5×10^3 µg/m^3
Water, Health: 5 x 100 = 500 µg/ℓ
Land, Health: 0.002 x 500 = 1 µg/g

Air, Ecology:
Water, Ecology: 5 x 5 = 25 µg/ℓ
Land, Ecology: 0.002 x 25 = 0.05 µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS AS CN:

$EPC_{AH1} = 10^3 \times 5/420 = 12$ µg/m^3
$EPC_{WH1} = 15 \times 12 = 180$ µg/ℓ
$EPC_{WH2} = 13.8 \times 5 = 69$ µg/ℓ
$EPC_{WHS} = 100$ µg/ℓ
$EPC_{LH} = 0.002 \times 100 = 0.2$ µg/g

$EPC_{WE1} = 50 \times 0.01 = 50$ µg/ℓ
$EPC_{WES} = 5$ µg/ℓ
$EPC_{LE} = 0.002 \times 5 = 0.01$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.0E3		12		
Water, $\mu g/l$ (ppm Wt)			5.0E2	2.5E1	100		
Land, $\mu g/g$ (ppm Wt)			1.0E0	5.0E-2	0.14	0.01	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			12		
Water, $\mu g/l$ (ppm Wt)	100	5			
Land, $\mu g/g$ (ppm Wt)			0.2	0.01	

CATEGORY: 48

WLN: P

PHOSPHORUS: P (white, yellow, red, violet, or black phosphorus).
A nonmetallic element; white, yellow, reddish brown, violet, yellow, or black amorphous powder or rhombic or monoclinic crystals.

STRUCTURE:

P_4 P^{+5}

P^{+3} P^{-3}

PROPERTIES:
Atomic number: 15; group 5a; atomic wt: 30.975; valency: +3, +5, -3;
White or yellow--molecular wt: 123.92; mp: 44; bp: 280; d: 1.82; insoluble; vap. d: 4.42; vap. press: 1 mm at 76.6°;
Red amorphous--mp: 590; bp: 280; d: 2.2; insoluble; vap. D: 4.77.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

See Phosphate, Phosphorus compounds.

Phosphorus is the second member of the nitrogen group. Elemental phosphorus forms numerous allotropic forms including white or yellow, red, and black phosphorus. White phosphorus is the most highly reactive and most toxic allotrope. Elemental phosphorus exists as P_4 rather than as atomic phosphorus. Red phosphorus is formed by heating white phosphorus to 240°C. Red phosphorus reacts slowly in water to form phosphate. Yellow phosphorus has a distinct odor (ref. 117).

Phosphorus often exists as a covalently bonded compound and it forms binary saltlike phosphides.

Occurrence in the Earth's crust is 0.12 percent (ref. 24). Phosphorus generally as phosphate occurs in all fertile soil. It is an essential constituent of protoplasm, nervous tissue, and bones (ref. 24).

In surface waters of the United States the average concentration of phosphorus (including elemental and combined species) is reported as 0.087 µg/ℓ, with a range of 0.001-5 µg/ℓ (ref. 28).

TOXIC PROPERTIES, HEALTH EFFECTS:

Red phosphorous is relatively harmless unless white phosphorus is present as an impurity.

Yellow or white phosphorus is one of the most highly toxic inorganic substances (ref. 4).

Chronic effects in man include liver injury, necrosis of jaw bone, anemia, brittle bones, and tooth and eye damage (ref. 9). The lowest lethal dose reported for a human is 1.4 mg/kg administered orally (ref. 2). Phosphorus may be absorbed through the skin, as well as by ingestion or through the respiratory tract (ref. 117).

LD_{50} (skin, rat): 100 mg/kg.

Aquatic toxicity: Elemental phosphorus is highly toxic and bioaccumulates in aquatic organisms; a concentration factor as high as 25,000 has been reported with the largest concentration found in liver (ref. 28). LC_{50} (48 hr) = 0.0105 ppm for Lepomis macrochirus (bluegill) (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (yellow or white phosphorus): 0.1 mg/m^3.

EPC 1976 Water Quality Criteria (proposed): 0.10 µg/ℓ yellow (elemental) phosphorus for marine or estuarine waters (ref. 33).

NAS/NAE 1972 Water Quality Criteria: For marine aquatic life and wildlife elemental phosphorus: hazard level--1 µg/ℓ; application factor--0.01 (to be applied to 96-hour LC_{50}).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 100 µg/m^3
Water, Health: $15 \times 100 = 1.5 \times 10^4$ µg/ℓ
Land, Health: $0.002 \times 1.5 \times 10^4 = 30$ µg/g

Air, Ecology:
Water, Ecology: $5 \times 0.1 = 0.5$ µg/ℓ
Land, Ecology: $0.002 \times 0.5 = 1 \times 10^{-3}$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.1/420 = 0.24$ µg/m^3
$EPC_{WH1} = 15 \times 0.24 = 3.6$ µg/ℓ
$EPC_{WH2} = 13.8 \times 0.1 = 1.4$ µg/ℓ
$EPC_{LH} = 0.002 \times 1.4 = 0.003$ µg/g

$EPC_{WE1} = 50 \times 0.0105 = 0.5$ µg/ℓ
$EPC_{WES} = 0.10$ µg/ℓ
$EPC_{LE} = 0.002 \times 0.1 = 0.0002$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, µg/m³ (ppm Vol)			1.0E2		0.24		
Water, µg/l (ppm Wt)			1.5E4	5 E-1	1.4	0.1	0.087†
Land, µg/g (ppm Wt)			3.0E1	1 E-3	0.003	0.0002	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, µg/m³ (ppm Vol)			0.24		
Water, µg/l (ppm Wt)		0.10	1.4		
Land, µg/g (ppm Wt)			0.003	0.0002	

†Concentration reflects both elemental and combined species.

CATEGORY: 48

WLN:

PHOSPHATE: PO_4^{-3}.
The anion of phosphoric acid.

STRUCTURE:

PO_4^{-3}

PROPERTIES:

Molecular wt: 94.97; soluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Phosphate occurs as a salt of phosphoric acid. It may exist as tertiary (M_3PO_4); monohydric (M_2HPO_4); or dihydric (MH_2PO_4) where M is a monovalent metal ion.

These salts are generally water soluble.

Background levels for total phosphorus including phosphate are reported below 100 μg/ℓ for rivers and below 50 μg/ℓ where streams enter lakes and reservoirs (ref. 69). Concentration in relatively uncontaminated lakes is usually 10 to 30 μg/ℓ total phosphorus (ref. 28). High phosphorus content is an important factor in eutrophication. Nuisance algae blooms have resulted from 0.3 $g/m^3/yr$ for a lake with a mean depth of 20 meters (ref. 28). The nitrogen/phosphorus ratio for natural waters is generally 10:1.

Total phosphate concentrations exceeding 100 μg/ℓ can interfere with the coagulation process in water-treatment plants (ref. 33).

TOXIC PROPERTIES, HEALTH EFFECTS:

Phosphate is not directly toxic to man or to aquatic organisms. It is a major algae nutrient and may affect aquatic life indirectly by contributing to the rate of eutrophication of lakes and reservoirs (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

A total phosphorus criterion to control nuisance aquatic growths is currently evolving but is not yet presented (ref. 33).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health:
Water, Health:
Land, Health:

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)							
Water, $\mu g/l$ (ppm Wt)							100 † < 50 ‡ 10-30 ‡
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)					
Water, $\mu g/l$ (ppm Wt)					
Land, $\mu g/g$ (ppm Wt)					

† For rivers

‡ Where streams enter lakes and reservoirs

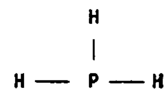
‡ Total phosphorus for lakes

CATEGORY: 48

WLN: H3 P

PHOSPHINE: PH_3 (hydrogen phosphide).
A colorless gas, odor of decaying fish.

STRUCTURE:



PROPERTIES:

Molecular Wt: 34.04; mp: -133; bp: -87.5; d: 1.529 g/ℓ at o° C; vap. press: 20 atm at -3° C; slightly soluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Phosphine is formed by the alkaline hydrolysis of phosphorus. The odor threshold is reported to be 0.021 ppm (ref. 29).

TOXIC PROPERTIES, HEALTH EFFECTS:

Phosphine is a very toxic gas. Acute poisoning is characterized by depression of the central nervous system and lung irritation. Chronic poisoning may result from continued exposure to very low concentrations (refs. 4, 9). The lowest reported concentration causing death for a person is 1,000 ppm; duration of the exposure is not specified. Inhalation of 8 ppm for 1 hour caused pulmonary effects in a human (ref. 2).

LD_{50} (inhalation, rat): 11 ppm for 4 hr.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.4 mg/m^3 (0.3 ppm) (this TLV does not take into consideration the possibility of chronic phosphorus poisoning from phosphine [ref. 4]).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 400 $\mu g/m^3$ (0.3 ppm)	Air, Ecology:
Water, Health: 15 x 400 = 6 x 10^3 µg/ℓ	Water, Ecology:
Land, Health:	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.4/420 = 0.95\ \mu g/m^3$

$EPC_{AH1a} = 0.3/420 = 0.0007$ ppm

$EPC_{WH1} = 15 \times 0.95 = 14\ \mu g/\ell$

$EPC_{WH2} = 13.8 \times 0.4 = 5.5\ \mu g/\ell$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			4.0E2		0.95 (0.0007)		
Water, μg/l (ppm Wt)			6.0E3		5.5		
Land, μg/g (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			0.95 (0.0007)		
Water, μg/l (ppm Wt)			5.5		
Land, μg/g (ppm Wt)					

CATEGORY: 49

WLN: AS

ARSENIC AND ARSENIC COMPOUNDS (AS ARSENIC): As (metallic arsenic, gray or black arsenic, yellow arsenic). Gray, brittle metal; hexagonal-rhombic crystals or yellow cubic crystals (As_4).

STRUCTURE:

As As_4
As^{-3} As^{+3}
As^{+5}

PROPERTIES:

Atomic number: 33; group: 5a; atomic wt: 74.92; mol. wt: 299.64; sublimes at 613° C; d: 5.729 at 14° C; vap. press: 1 mm at 372° C; valency: -3, +3, +5; insoluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Arsenic occurs widely in nature as the sulfide, arsenide and sulfarsenides of heavy metals. The compounds formed are analogous to those of phosphorous. Yellow arsenic, the nonmetallic form, As_4 is formed at 500° C by rapid condensation of arsenic vapor. It is photosensitive and changes to gray arsenic on exposure to light. Arsenic forms three series of compounds: -3: arsenides (M_3As where M is a monovalent metal); +3: arsenous; +5: arsenic. Arsenic acid ($H_3AsO_4 \cdot 1/2H_2O$) is water soluble. An arsenate is a salt of arsenic acid and contains the radical AsO_4^{-3}. See also Arsenic Trioxide and Arsine.

Rural background concentration of arsenic in air is reported as 0.05 ng/m^3 (ref. 1). The natural concentration of arsenic in seawater is 2.6 μg/ℓ (ref. 28).

Background levels in freshwater as indicated from hydrologic benchmark samples is 0-20 μg/ℓ (refs. 28, 69). Arsenic content in U.S. drinking water supplies ranges from a trace to 0.1 mg/ℓ (ref. 28).

The total daily intake of arsenic from food averages 900 μg for adults (ref. 28).

A range of 0.2-80 kg/ha of As exists in soils with a typical level around 12 kg/ha (ref. 118).

Occurrence of arsenic in the earth's crust is 0.0005 percent (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

The toxicity of arsenic is believed to be related to its valence state, the trivalent species being the most toxic. Compounds of arsenic may be absorbed by inhalation, ingestion, and through the skin (ref. 117). Excretion is slow, requiring up to 10 days after acute absorption and sometimes more than a year after prolonged absorption (ref. 117). Arsenic is a cumulative poison producing long-term chronic effects in mammals. Industrial poisoning due to arsenic has caused dermatitis, pharyngitis, conjunctivitis, and perforation of the nasal septum (ref. 4).

LD_{Lo} (intramuscular, rat): 25 mg/kg.

The amounts of As (primarily in its arsenate form) producing toxicity in sensitive plants vary from 110-340 kg/ha for sandy to clayey soils respectively (ref. 28). A concentration of 0.5 mg/ℓ in nutrient solutions is toxic to pineapple, and orange seedlings, and reduces tomato yields by 80 percent (ref. 33). Arsenic concentrations of 1.1 to 2.2 mg/ℓ are toxic to pike perch (Stizostedion vitreum) in 2 days (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV: 0.5 mg/m^3 (for arsenic and compounds [as metal]).

Intended change--TLV: 0.25 mg/m^3 (for inorganic compounds, as As).

Inorganic arsenic is the subject of a NIOSH Criteria Document. NIOSH recommends that no worker be exposed to > 0.002 mg/m^3. Compliance with all sections of the recommended standard will prevent noncarcinogenic adverse effects from arsenic (ref. 119).

Arsenic is under study for National Emissions Standards for Hazardous Air Pollutants (ref. 16). It is a candidate for the list for Toxic Pollutant Effluent Standards (ref. 10). It appears on the EPA Consent Decree Priority I List.

FDA lists permissible levels of arsenic in food as follows--muscle meats: 0.5 ppm; edible meat by-products: 1.0 ppm; eggs: 0.5 ppm (ref. 28).

EPA 1976 Water Quality Criteria (proposed): For domestic water supplies (health)--50 μg/ℓ; for irrigation of crops--100 μg/ℓ (ref. 33).

NAS/NAE 1972 Water Quality Criteria: For public water supply sources--0.1 mg/ℓ; for marine aquatic life: hazard level--0.05 mg/ℓ; minimal risk of deleterious effects--0.01 mg/ℓ; application factor--0.01 (to be applied to 96-hour LC_{50}); for livestock--0.2 mg/ℓ; for irrigation--0.10 mg/ℓ (for continuous use on all soils) (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 2 μg/m^3

Water, Health: 5 x 50 = 250 μg/ℓ

Land, Health: 0.002 x 250 = 0.5 μg/g

Air, Ecology:

Water, Ecology: 5 x 10 = 50 μg/ℓ

Land, Ecology: 0.002 x 50 = 0.1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH1} = 2/420 = 0.005 μg/m^3

EPC_{WH1} = 15 x 0.005 = 0.75 μg/ℓ

EPC_{WH2} = 13.8 x 0.002 = 0.03 μg/ℓ

EPC_{WES} = 50 μg/ℓ

EPC_{LH} = 0.002 x 50 = 0.1 μg/g

EPC_{WES} = 10 μg/ℓ

EPC_{LE} = 0.002 x 10 = 0.02 μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.0E0		0.005		0.00005
Water, $\mu g/l$ (ppm Wt)			2.50E2	5.0E1	50	10	0-20, 2.6 †
Land, $\mu g/g$ (ppm Wt)			5.0E-1	1.0E-1	0.1	0.02	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.005		
Water, $\mu g/l$ (ppm Wt)	50	10			
Land, $\mu g/g$ (ppm Wt)			0.1	0.02	

† For seawater

CATEGORY: 49

WLN: AS H3

ARSINE: AsH_3 (arsenic hydride, hydrogen arsenide, arsenous hydride, arseniuretted hydrogen).
A colorless gas, garlic odor.

STRUCTURE:

```
    H
    |
H - As - H
```

PROPERTIES:

Molecular wt: 77.92; mp: -116.3; bp: -55; d: 2.695 (gas), 1.689 at 84.9 (liquid); vap. d: 2.66; solubility: 20 mℓ per 100 mℓ H_2O.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Arsine may be formed by the reduction of arsenic compounds in acid by active metals such as zinc or magnesium. Odor recognition level for arsine is 1.84 mg/m^3 (ref. 3). This is equivalent to approximately 0.6 ppm.

Arsine decomposes when heated to 300°, depositing arsenic. On exposure to light, moist arsine decomposes quickly, depositing arsenic.

TOXIC PROPERTIES, HEALTH EFFECTS:

Arsine is extremely toxic; 3 to 10 ppm can cause poisoning symptoms in a few hours. A number of cases of chronic poisoning are also reported. Arsine poisoning is characterized by anemia resulting from hemolysis (refs. 4, 9). A concentration of 3 ppm has caused red blood cell effects in a human; 25 ppm for 30 minutes has caused death (ref. 2).

Arsine is a recognized carcinogen (ref. 9).

See Arsenic and Arsenic Compounds.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (0.05 ppm).

1975 NIOSH recommendation for occupational exposure to inorganic arsenic, including arsine, as As: 2 $\mu g/m^3$ (ref. 119).

Arsenic is under study for National Emissions Standards for Hazardous Air Pollutants (ref. 16). It is a candidate for the list for Toxic Pollutant Effluent Standards (ref. 10). It appears on the EPA Consent Decree Priority I List.

Criteria for arsenic in water are as follows:

EPA 1976 Water Quality Criteria (proposed): For domestic water supplies (health)--50 μg/ℓ; for irrigation of crops--100 μg/ℓ (ref. 33).

NAS/NAE 1972 Water Quality Criteria: For public water supply sources--0.1 mg/ℓ; for marine aquatic life: hazards level--0.05 mg/ℓ; minimal risk of deleterious effects--0.01 mg/ℓ; application factor--0.01 (to be applied to 96-hour LC_{50}); for livestock--0.2 mg/ℓ; for irrigation--0.10 mg/ℓ (for continuous use on all soils) (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS: (as As)

Air, Health: 2 $\mu g/m^3$

Water, Health: 5 x 50 = 250 μg/ℓ

Land, Health: 0.002 x 250 = 0.5 μg/g

Air, Ecology:

Water, Ecology: 5 x 10 = 50 μg/ℓ

Land, Ecology: 0.002 x 50 = 0.1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS: (as As)

EPC_{AH1} = 2/420 = 0.005 $\mu g/m^3$

EPC_{WH1} = 15 x 0.005 = 0.08 μg/ℓ

EPC_{WH2} = 13.8 x 0.002 = 0.03 μg/ℓ

EPC_{WHS} = 50 μg/ℓ

EPC_{LH} = 0.002 x 50 = 0.1 μg/g

EPC_{WES} = 10 μg/ℓ

EPC_{LE} = 0.002 x 10 = 0.02 μg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.0E0		0.005		
Water, $\mu g/l$ (ppm Wt)			2.50E2	5.0E1	50	10	
Land, $\mu g/g$ (ppm Wt)			5.0E-1	1.0E-1	0.1	0.02	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.005		
Water, $\mu g/l$ (ppm Wt)	50	10			
Land, $\mu g/g$ (ppm Wt)			0.1	0.02	

CATEGORY: 49

ARSENIC TRIOXIDE: As_2O_3 (arsenic (III) oxide, arsenic sesquioxide, arsenous anhydride, arsenous oxide, arsenous oxide anhydride, white arsenic).
White, odorless, tasteless, amorphous powder or transparent crystals.

WLN: AS2.03

STRUCTURE:

As_2O_3

PROPERTIES:

Molecular wt: 197.84; mp: 315° C (sublimes); d: 3.738; solubility: 3.7 g/100 mℓ at 20° C, 10.1 g/100 mℓ at 100° C; percent arsenic: 76.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Arsenic trioxide is associated with particulate matter in the atmosphere. Normal density of As_2O_3 is 3.7 g/cm^3; floc density is 0.91 g/cm^3 for As_2O_3 agglomerates (ref. 3).

In production of arsenic trioxide (white arsenic) as a byproduct of copper ore roasting, the As_2O_3 is typically contaminated with 0.06 % Pb, 1.9 % Sb_2O_3, and traces of water (ref. 4).

TOXIC PROPERTIES, HEALTH EFFECTS:

Arsenic trioxide has been shown to be acutely toxic to animals and humans. Occupational exposures have resulted in contact dermatitis and sensitization, conjunctivitis, and ulceration and perforation of the nasal system (ref. 4).

LD_{50} (oral, rat): 20 mg/kg.

Inhalation of 700 μg/m^3 for 1 year is reported to have caused a carcinogenic response in humans. The EPA/NIOSH ordering number for As_2O_3 is 7121. It is not possible to determine the dosage effecting the carcinogenic response; hence it is not possible to calculate an adjusted ordering number. Arsenic trioxide fed to mice did not produce tumors (ref. 91). The International Agency for Research on Cancer has concluded that the role of arsenic is uncertain in the increased lung cancer risk among smelter workers (ref. 91).

Aquatic toxicity: TLm 96: 10-1 ppm.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (production, as As) = 0.05 mg/m^3 (arsenic trioxide production is recognized by ACGIH to have carcinogenic or cocarcinogenic potential).

1975 NIOSH recommendation for occupational exposure to inorganic arsenic, including arsenic trioxide, as As: 2 μg/m^3 (ref. 119).

Arsenic is under study for National Emissions Standards for Hazardous Air Pollutants (ref. 16). It is a candidate for the list for Toxic Pollutant Effluent Standards (ref. 10). It appears on the EPA Consent Decree Priority 1 List.

Criteria for arsenic in water are as follows:

EPA 1976 Water Quality Criteria (proposed): For domestic water supplies (health)--50 μg/ℓ; for irrigation of crops--100 μg/ℓ (ref. 33).

NAS/NAE 1972 Water Quality Criteria: For public water supply sources--0.1 mg/ℓ; for marine aquatic life: hazard level--0.05 mg/ℓ; minimal risk of deleterious effects--0.01 mg/ℓ; application factor--0.01 (to be applied to 96-hour LC_{50}); for livestock--0.2 mg/ℓ; for irrigation--0.10 mg/ℓ (for continuous use on all soils) (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS: (as As)

Air, Health: 2 μg/m^3	Air, Ecology:
Water, Health: 5 x 50 = 250 μg/ℓ	Water, Ecology: 5 x 10 = 50 μg/ℓ
Land, Health: 0.002 x 250 = 0.5 μg/g	Land, Ecology: 0.002 x 50 = 0.1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS: (as As)

EPC_{AH1} = 2/420 = 0.005 μg/m^3	
EPC_{WH1} = 15 x 0.005 = 0.08 μg/ℓ	EPC_{WE1} = 50 x 1 = 50 μg/ℓ
EPC_{WH2} = 13.8 x 0.002 = 0.03 μg/ℓ	
EPC_{WHS} = 50 μg/ℓ	EPC_{WES} = 10 μg/ℓ
EPC_{LH} = 0.002 x 50 = 0.1 μg/m^3	EPC_{LE} = 0.002 x 10 = 0.02 μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.0E0		0.005		
Water, $\mu g/l$ (ppm Wt)			2.50E2	5.0E1	50	10	
Land, $\mu g/g$ (ppm Wt)			5.0E-1	1.0E-1	0.1	0.2	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.005		
Water, $\mu g/l$ (ppm Wt)	50	10			
Land, $\mu g/g$ (ppm Wt)			0.1	0.02	

CATEGORY: 50

WLN: SB

ANTIMONY AND ANTIMONY COMPOUNDS (AS ANTIMONY): Sb (antimony black, stibium).

Rhombohedral, blue-white, brittle, lustrous substance.

STRUCTURE:

Sb	Sb_4	Sb^{+3}
SbR_3	SbO_2^-	SbO^+

(R is an alkyl group.)

PROPERTIES:

Atomic number: 51; group 5a; atomic wt: 121.75; mp: 630.5; bp: 1,380; d: 6.684 at 25°; vap. press: 1mm at 886° C; valency: +3, +5; insoluble

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Antimony is a metal of the arsenic family. It forms compounds analogous to those of phosphorous and arsenic. Compounds derived from trivalent antimony are more common and include antimonous or stibnous, (Sb^{+3}); stibines (SbR_3, where R is an alkyl group); antimonites, (SbO_2^-); and antimonyl, (SbO^+). The most important antimony-containing mineral is stibnite, Sb_2S_3 (ref. 96).

A concentration of 7.4 ng/m^3 has been reported in urban air (ref. 1). Natural concentration in seawater is 0.45 µg/ℓ (ref. 28).

TOXIC PROPERTIES, HEALTH EFFECTS:

Effects of intoxication may include skin irritation, inflammation of mucous membranes, and nervous system and gastrointestinal effects (ref. 9).

Chronic poisoning may result from inhalation of antimony or its compounds. The lowest toxic concentration reported for human is 4,700 $\mu g/m^3$ for 20 weeks.

The relative order of toxicity, intraperitoneally, of antimony compounds beginning with the most toxic is: metallic antimony, antimony trisulfide, antimony pentasulfide, antimony trioxide, and antimony pentoxide (ref. 4).

LD_{50} (oral, rat): 100 mg/kg for antimony.

Toxicity to aquatic life: The 96-hr LC_{50} for fathead minnow is 80 ppm (antimony trioxide) (ref. 28). This is equivalent to 67 ppm as Sb.

Antimony can be concentrated by various marine forms to over 300 times the amount present in seawater (ref. 28). Concentrations as low as 1 mg/ℓ, as Sb, have produced effects in fish (ref. 10).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV: 0.5 mg/m^3 (for antimony and compounds [as Sb] except antimony trioxide).

Antimony compounds are included in the EPA Consent Decree Priority III List.

Antimony is a candidate for the list for Toxic Pollutant Effluent Standards (ref. 10).

NAS/NAE Water Quality Criteria, 1972: For marine aquatic life--hazard level: 0.2 mg/ℓ; application factor: 0.02 (to be applied to the 96-hour LC_{50}) (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 500 $\mu g/m^3$ (except Sb_2O_3)

Water, Health: $15 \times 500 = 7.5 \times 10^3$ µg/ℓ

Land, Health: $0.002 \times 7.5 \times 10^3 = 15$ µg/g

Air, Ecology:

Water, Ecology: 200 µg/ℓ

Land, Ecology: $0.002 \times 200 = 0.4$ µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.5/420 = 1.2\ \mu g/m^3$

$EPC_{WH1} = 15 \times 1.2 = 18$ µg/ℓ

$EPC_{WH2} = 13.8 \times 0.5 = 7$ µg/ℓ

$EPC_{LH} = 0.002 \times 7 = 0.014$ µg/g

$EPC_{WE3} = 0.2 \times 200 = 40$ µg/ℓ

$EPC_{LE} = 0.002 \times 40 = 0.08$ µg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.0E2		1.2		0.007 †
Water, $\mu g/l$ (ppm Wt)			7.5E3	2.0E2	7	40	0.45 ‡
Land, $\mu g/g$ (ppm Wt)			1.5E1	4.0E-1	0.014	0.08	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			1.2		
Water, $\mu g/l$ (ppm Wt)			7	40	
Land, $\mu g/g$ (ppm Wt)			0.014	0.08	

† Reported for urban air. No rural concentration is reported.

‡ For seawater

CATEGORY: 50

WLN:

ANTIMONY TRIOXIDE: Sb_2O_3 (antimonous oxide).
A colorless or white, cubic or rhombic, odorless, tasteless powder.

STRUCTURE:

Sb_2O_3

PROPERTIES:

Molecular wt: 291.5; mp: 656; bp: 1550 (sublimes); d: 5.2; slightly soluble; vap. press: 1 mm at 574° C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Antimony trioxide is associated with particulate matter in the atmosphere. Normal density for Sb_2O_3 is 5.57 g/cm^3; floc density is 0.63 g/cm^3 (ref. 3).

TOXIC PROPERTIES, HEALTH EFFECTS:

Chronic daily inhalation of high levels (45 mg/m^3) by guinea pigs resulted in pneumonitis and liver effects; occasional exposure to rats did not produce such effects.

Carcinogenic effects in test animals are not reported in the references cited for this report.

LD_{50} (oral, rat): >20 g/kg (ref. 24).

Aquatic toxicity: The acute dose 96-hour LC_{50} is 80 ppm for fathead minnow, *Pimephales promelas* (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV: 0.5 mg/m^3 (for handling and use, as Sb).

Antimony trioxide production is classified by ACGIH as suspect of carcinogenic potential for man. TLV: 0.05 mg/m^3 (for antimony trioxide production).

Antimony compounds are included in the EPA Consent Decree Priority III List.

Antimony is a candidate for the list for Toxic Pollutant Effluent Standards (ref. 10).

NAS/NAE Water Quality Criteria, 1972, for antimony: For marine aquatic life--hazard level: 0.2 mg/ℓ; application factor: 0.02 (to be applied to the 96-hour LC_{50}) (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 50 μg/m^3

Water, Health: 15 x 50 = 750 μg/ℓ

Land, Health: 0.002 x 750 = 1.5 μg/g

Air, Ecology:

Water, Ecology: 200 μg/ℓ, as Sb

Land, Ecology: 0.002 x 200 = 0.4 μg/g, as Sb

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.5/420 = 1.2$ μg/m^3, as Sb

$EPC_{WH1} = 15 \times 1.2 = 18$ μg/ℓ, as Sb

$EPC_{WH2} = 13.8 \times 0.5 = 7$ μg/ℓ, as Sb

$EPC_{LH} = 0.002 \times 7 = 0.014$ μg/g, as Sb

$EPC_{AC1} = 50/420 = 0.1$ μg/m^3

$EPC_{WC} = 15 \times 0.1 = 1.5$ μg/ℓ

$EPC_{LC} = 0.002 \times 1.5 = 0.003$ μg/g

$EPC_{WE3} = 0.2 \times 200 = 40$ μg/ℓ, as Sb

$EPC_{LE} = 0.002 \times 40 = 0.08$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
Category	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.0E1		0.1		
Water, $\mu g/l$ (ppm Wt)			7.5E2	2.0E2	1.5	40	
Land, $\mu g/g$ (ppm Wt)			1.5E0	4.0E-1	0.003	0.08	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			1.2		0.1
Water, $\mu g/l$ (ppm Wt)			7	40	1.5
Land, $\mu g/g$ (ppm Wt)			0.014	0.08	0.003

CATEGORY: 51

BISMUTH AND BISMUTH COMPOUNDS (AS BISMUTH): Bi.

A pink, silvery, brittle metal of the arsenic group.

WLN: BI

STRUCTURE:

Bi $\underline{Bi^{+3}}$ Bi^{+5}

BiO^- M_3Bi BiR_3

[M is a monovalent metal; R is an alkyl group]

PROPERTIES:

Atomic number: 83; group 5a, atomic wt: 208.98; mp: 271.3; bp: 1,420-1,560; d: 9.8; valency: +3, +5; insoluble; diamagnetic; vap. press: 1 mm at 1,021° C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Bismuth forms two series of compounds. Trivalent compounds are: Bismuthides (M_3Bi), Bismuthans (Bi^{+3}), Bismuthyl (BiO^-), and Bismuthines (BiR_3). (M is a monovalent metal and R is an alkyl group.) Pentavalent compounds are called Bismuthic (Bi^{+5}).

Rural background concentration in air is 0.0004 $\mu g/m^3$ to 0.0030 $\mu g/m^3$ (ref. 1). Natural concentration in seawater is 0.02 $\mu g/\ell$ (ref. 28).

Occurrence in the Earth's crust is 0.2 ppm (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

Bismuth is considered as one of the less toxic of the heavy metals. However, it can cause kidney damage and behaves similarly to lead in the body (ref. 9).

LD_{50} for dihydroxypropoxy bismuth (intravenous, rat): 13 mg/kg; molecular wt, dihydroxypropoxy bismuth: 302. (as Bi): 209/302 x 13 = 9 mg/kg (based on LD_{50} for dihydroxypropoxy bismuth).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

A TLV has been specified for bismuth telluride, Bi_2Te_3 = 10 mg/m^3; the effects of exposure appear to be mild and reversible (ref. 4).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 45 x 9 = 405 $\mu g/m^3$

Water, Health: 15 x 405 = 6.1 x 10^3 $\mu g/\ell$

Land, Health: 0.002 x 6.1 x 10^3 = 12 $\mu g/g$

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH2} = 0.107 x 9 = 1.0 $\mu g/m^3$

EPC_{AH3} = 0.081 x 9 = 0.7 $\mu g/m^3$

EPC_{WH1} = 15 x 0.7 = 10.5 $\mu g/\ell$

EPC_{WH2} = 0.4 x 9 = 3.6 $\mu g/\ell$

EPC_{LH} = 0.002 x 3.6 = 0.007 $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.1E2		0.7		0.0004-0.003
Water, $\mu g/l$ (ppm Wt)			6.1E3		3.6		0.02†
Land, $\mu g/g$ (ppm Wt)			1.2E1		0.007		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.7		
Water, $\mu g/l$ (ppm Wt)			3.6		
Land, $\mu g/g$ (ppm Wt)			0.007		

† For seawater

CATEGORY: 52

WLN: 000

OZONE: O_3 (triatomic oxygen).
A faint blue gas, characteristic, pungent odor.

STRUCTURE:

PROPERTIES:

Molecular wt: 48.0; mp: -193; bp: -111.9;
gas d: 2.144 g/ℓ at 0° C; soluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Ozone occurs at low concentrations in the earth's atmosphere. It is formed at a high altitude when oxygen molecules dissociate into oxygen atoms, which in turn recombine with oxygen molecules, giving off energy to another molecule. Ozone is also produced by a photochemical reaction in smog. The normal concentration of ozone in air near the Earth's surface varies from 0.01 to 0.02 ppm, 20 to 40 $\mu g/m^3$ (ref. 48).

Ozone is the principal oxidizing agent of photochemical smog.

Ozone reacts with olefins to form numerous free radical aldehydes, carboxylic acids, polymers, etc. (ref. 120).

The detectable odor level for ozone is reported as < 0.02-0.05 ppm (ref. 120).

TOXIC PROPERTIES, HEALTH EFFECTS:

The major physiological effects of exposure to ozone are on the respiratory system, causing mucous membrane irritation and pulmonary edema (ref. 107). Acute effects (injurious or lethal) may result from exposure to a few ppm. The lowest concentration producing pulmonary effects in humans is 1 ppm, and a concentration of 0.2 ppm for 3 hours affected eyes (ref. 2).

LD_{50} (inhalation, rat): 4.8 ppm/4 hrs. Discomfort in humans results from exposure to concentrations of 0.05 to 0.10 ppm for 13 to 30 minutes (ref. 120). Indications are that long-term exposure to even lower levels of ozone contribute to premature aging.

One neoplastic response resulting from exposure to ozone is reported: TC_{Lo} (inhalation, mouse): 4.5 ppm/50 hrs intermittent. The EPA/NIOSH ordering number is 3111. Assuming a breathing volume of 0.021 ℓ/min and 25 g as the weight of the mouse, 4.5 ppm for 50 hrs corresponds to a dosage of 22 mg/kg if all the ozone is absorbed. The adjusted ordering number is 141.

Ozone produces a mottling or bleaching on the upper surfaces of plant leaves.

A concentration of 0.03 ppm for 4 hrs has an effect on conifer needles (ref. 3); 0.03 ppm ozone in combination with sulfur dioxide causes injury to tobacco leaves (ref. 7); 0.03 ppm is equivalent to approximately 60 $\mu g/m^3$. Ozone is destructive to certain materials, such as rubber, and causes fading of dyes.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (0.1 ppm).

Total oxidant, of which ozone is an important component, is used as an index of photochemical smog.

National Primary and Secondary Ambient Air Quality Standard for photochemical oxidants: 160 $\mu g/m^3$ (0.08 ppm), 1-hour average, expressed as ozone by the Federal Reference Method (ref. 110).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 200 $\mu g/m^3$ (0.1 ppm)
Water, Health:
Land, Health:

Air, Ecology: $60 \times 4/24 = 10\ \mu g/m^3$
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.2/420 = 0.5\ \mu g/m^3$
$EPC_{AH1a} = 0.1/420 = 0.00002$ ppm
$EPC_{AHS} = 160\ \mu g/m^3$ (0.08 ppm), for photochemical smog control
$EPC_{AC2} = 10^3/(6 \times 141) = 1.2\ \mu g/m^3$

$EPC_{AE} = 0.06 \times 0.1 \times 4/24 = 0.001\ \mu g/m^3$

Background concentrations should not be exceeded.

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, µg/m³ (ppm Vol)			2.0E2 (0.1)	1.0E1	160 (0.08)	160 (0.08)	20 - 40
Water, µg/l (ppm Wt)							
Land, µg/g (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, µg/m³ (ppm Vol)	160† (0.08)	160† (0.03)			
Water, µg/l (ppm Wt)					
Land, µg/g (ppm Wt)					

† Standard considers effects of photochemical smog, not specific health effects of ozone.

CATEGORY: 53

WLN: SCO

CARBONYL SULFIDE: COS (Carbon oxysulfide).
A colorless gas.

STRUCTURE:

S = C = O

PROPERTIES:

Molecular wt: 60.07; mp: -138; bp: -50.2; d: (liq) 1.24 at -87° C; (gas) 1.073; vap. d: 2.1; solubility: 54 mℓs per 100 mℓs at 20° C; vap. press: 760 mm at -49.9° C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Carbonyl sulfide liberates H_2S upon decomposition/reduction.
Although slightly soluble in water, carbonyl sulfide is an air contaminant rather than a water problem.

TOXIC PROPERTIES, HEALTH EFFECTS:

Carbonyl sulfide may be narcotic in high concentration. It is only a slight irritant to the lungs and acts principally upon the central nervous system (ref. 117).

LC_{Lo} (inhalation, mouse): 2,900 ppm for 24 hrs. This is equivalent to 7,102 mg/m^3. Assuming absorption of the total amount of contaminant in the breathing volume, this concentration over 24 hours corresponds to a dosage of 9,828 mg/kg. (The weight of the mouse is estimated as 25 g and tidal breathing rate as 0.024 ℓ/min (refs. 2,3). Derived LD_{Lo}: 9,828 mg/kg.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $45 \times 9{,}828 = 4.4 \times 10^5$ μg/m^3
Water, Health:
Land, Health:

Air, Ecology:
Water, Ecology:
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH2} = 0.107 \times 9{,}828 = 1{,}050$ μg/m^3
$EPC_{AH3} = 0.081 \times 9{,}828 = 800$ μg/m^3

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.4E5		800		
Water, $\mu g/l$ (ppm Wt)							
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			800		
Water, $\mu g/l$ (ppm Wt)					
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 53

WLN: H2 S

HYDROGEN SULFIDE: H_2S (sulfur hydride, hydrosulfuric acid).
Colorless, poisonous, flammable gas with odor of rotten eggs.

STRUCTURE:

H_2S

PROPERTIES:

Molecular wt: 34.08; mp: -85.5; bp: -60.4;
d: 1.539; vap. press: 20 atmos. at 25.5° C;
vap. d: 1.189; very soluble: 4,000 mg/ℓ at 20° C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Hydrogen sulfide is a significant pollutant in both air and water. The odor recognition level for hydrogen sulfide gas is reported as low as 0.0015 mg/m^3 (ref. 3); the perception level is 0.002 mg/ℓ (ref. 24). In water, soluble sulfides react to form HS^- or H_2S. The equilibrium between HS^- and H_2S is affected by the pH of the water, formation of H_2S being favored by low pH.

Hydrogen sulfide may be generated by the anaerobic decomposition of organic matter in water (ref. 28).

TOXIC PROPERTIES, HEALTH EFFECTS:

Exposure to high concentrations (500-1,000 ppm) of H_2S may result in systemic poisoning (ref. 4). The primary effect resulting from exposure to low concentrations (< 20 ppm) is to the eyes (conjunctivitis). The biological half-life of hydrogen sulfide is reported as < 20 min (ref. 22).

Death of a human resulted from inhalation of 600 ppm for 30 minutes (ref. 2).

LD_{50} (inhalation, rats): 713 ppm (1 hr).

Exposure to H_2S is reported to cause marking of leaves of plants, particularly young plants; 150,000 μg/m^3 for 4 hours caused 100 percent marking of leaf area of lamb's quarters (Chenopodium murale) (ref. 3). Molecular H_2S is highly toxic to fishes. Effects to bluegill are reported from concentrations of 0.001 mg/ℓ (ref. 121). Both acute and chronic effects from exposure have been noted in various species (refs. 28, 121). At levels of 0.02-0.7 mg/ℓ, walleye (Stizostedion vitreum) eggs did not hatch (ref. 33). 96-hour LC_{50} for northern pike (Esox lucius): 17-32 μg/ℓ (ref. 33).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 15 mg/m^3 (10 ppm) (this level is specified to prevent eye injury; odor threshold is much higher).

EPA, 1976 Water Quality Criteria (proposed): 2 μg/ℓ as undissociated H_2S for fish and other aquatic life, fresh and marine water (ref. 33).

NAS/NAE 1972 Water Quality Criteria for sulfide: For freshwater aquatic life--0.002 mg/ℓ; for marine aquatic life--hazard level: 0.01 mg/ℓ; minimal risk of deleterious effects: 0.005 mg/ℓ; application factor: 0.1 (to be applied to the 96-hour LC_{50} (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.5×10^4 μg/m^3 (10 ppm)
Water, Health: $15 \times 1.5 \times 10^3 = 2.25 \times 10^4$ μg/ℓ
Land, Health:

Air, Ecology:
Water, Ecology: $5 \times 2 = 10$ μg/ℓ
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 15/420 = 36$ μg/m^3
$EPC_{AH1a} = 10/420 = 0.024$ ppm
$EPC_{WH1} = 15 \times 36 = 540$ μg/ℓ
$EPC_{WH2} = 13.8 \times 15 = 207$ μg/ℓ

$EPC_{WES} = 2$ μg/ℓ

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.5E4 (10)		36 (0.024)		
Water, $\mu g/l$ (ppm Wt)			2.3E4	1.0E1	207	2	
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			36 (0.024)		
Water, $\mu g/l$ (ppm Wt)		2	207		
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 53

WLN: SCS

CARBON DISULFIDE: CS_2 (carbon bisulfide).
Clear, colorless liquid; characteristic odor.

STRUCTURE:

CS_2

PROPERTIES:

Molecular wt: 76.13; mp: -110.8; bp: 46.5;
d: 1.261; vap. press: 400 mm at 28° C; vap. d: 2.64;
water solubility: 0.22 g at 25°.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Although carbon disulfide is a liquid at standard conditions, it has a very high vapor pressure. It is significant primarily as an air contaminant. The odor recognition level of CS_2 is 0.05 to 2.6 mg/m^3 (refs. 3, 29). Upon decomposition in air, carbon disulfide emits SO_2 and SO_3.

Carbon disulfide undergoes hydrolysis to hydrogen sulfide when treated with water or alkali at 400° to 500° C. With sulfide ion, CS_2 may form thiocarbonates, CS_3^{-2}.

TOXIC PROPERTIES, HEALTH EFFECTS:

Carbon disulfide may be absorbed through skin as well as through the lungs. Both acute and chronic exposures damage the central nervous system. Repeated exposure to levels of 40 to 50 ppm have been associated with headache, fatigue, irritability, insomnia, and other symptoms (ref. 4).

Ingestion of 14 mg/kg resulted in the death of a human; 4,000 ppm for 30 minutes also caused a death. Central nervous system effects resulted from a concentration of 50 mg/m^3 for 7 years (ref. 2).

The biological half-life for carbon disulfide is reported as 0.036 days and for its metabolite, 0.058 days (ref. 20).

LD_{LO} (intraperitoneal, rat): 400 mg/kg

See also Hydrogen Sulfide.

Aquatic toxicity: TLm 96: 1,000-100 ppm.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (skin) = 60 mg/m^3 (20 ppm) (the TLV is established to prevent systemic effects; the odor recognition level is much higher).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 6.0×10^4 μg/m^3 (20 ppm)
Water, Health: $15 \times 6.0 \times 10^4 = 9 \times 10^5$ μg/ℓ
Land, Health:

Air, Ecology:
Water, Ecology: $100 \times 100 = 1.0 \times 10^4$ μg/ℓ
Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 60/420 = 143$ μg/m^3
$EPC_{AH1a} = 20/420 = 0.05$ ppm
$EPC_{WH1} = 15 \times 143 = 2,150$ μg/ℓ
$EPC_{WH2} = 13.8 \times 60 = 830$ μg/ℓ

$EPC_{WE1} = 50 \times 100 = 5,000$ μg/ℓ

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			6.0E4 (20)		143 (0.05)		
Water, $\mu g/l$ (ppm Wt)			9.0E5	1.0E4	830	5,000	
Land, $\mu g/g$ (ppm Wt)							

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			143 (0.05)		
Water, $\mu g/l$ (ppm Wt)			830	5,000	
Land, $\mu g/g$ (ppm Wt)					

CATEGORY: 54

WLN: SE

SELENIUM AND SELENIUM COMPOUNDS (AS SELENIUM): Se.

Steel-gray, nonmetallic element; amorphous, or crystalline.

STRUCTURE:

Se Se^{+4} Se^{-2} Se^{+6}

PROPERTIES:

Atomic no: 34; group 6; atomic wt: 78.96; valency: 2, 4, 6.

	mp	d	bp	solubility	vap. press
Gray	217	4.81	688	insol	1 mm at 356°C
Amorphous		4.28		reacts with water	
Crystalline	~200	4.46		--	

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Selenium is a member of the sulfur family and resembles sulfur in its various forms and in its compounds.

Urban concentration of selenium in air is reported as 4.4 ng/m^3 (ref. 1). Concentration in freshwater as indicated from hydrologic benchmark stations ranged from 0 to 22 µg/ℓ; out of 16 samples, 5 were zero (ref. 64). Natural concentration in seawater is 0.45 µg/ℓ (ref. 28). Selenium occurs in nature usually in the sulfide ores of the heavy metals (ref. 24). Selenium may be present in soil as basic ferric selenate, calcium selenate, and as elemental selenium. It is present in the Earth's crust at about 0.09 ppm (ref. 24). Normal soil concentrations are low, from 0.02 to 4.0 kg/ha. A typical level is 0.4 kg/ha (ref. 118).

Selenium is recognized as a dietary essential for humans; daily requirement is 200 µg for adults.

TOXIC PROPERTIES, HEALTH EFFECTS:

Both acute and chronic effects from exposure to selenium are reported. It can be inhaled, ingested, or absorbed through the skin (ref. 117). Symptoms appear similar to those of arsenic poisoning (ref. 33). It can cause respiratory tract irritation and systemic effects.

LD_{50} (intravenous, rat): 6 mg/kg; LC_{Lo} (inhalation, rat): 33 mg/kg/8 hr.

Oncogenic effects resulting from exposure to selenium are not reported although teratogenic effects were produced in chicks and in mice (ref. 32). The EPA/NIOSH ordering number based on teratogenic responses is 3213. The lowest dosage reported to cause a teratogenic effect is 0.5 mg/kg. The adjusted ordering number is 6426.

Aquatic toxicity: Selenium is considered dangerous to the aquatic environment. It may be passed through the food chain and accumulated in fish. As sodium selenite, 2.0 mg/ℓ are toxic to goldfish (*Carassius auratus*) in 8 days (ref. 33).

Small amounts of selenium added to soils may increase the selenium content in forages. Concentrations in soil of 0.2 kg/ha can produce 1.0 to 10.5 mg/kg in tissues of forage and vegetable crops. Cattle are adversely affected by concentrations > 4 mg Selenium per kg of forage (ref. 28). Crop plants are damaged by accumulation of large amounts of selenium. Some grain crops will exhibit chlorosis. There is usually inhibition of growth (ref. 122).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV: 0.2 mg/m^3 (for selenium compounds, as Se).

Selenium is a candidate for the list for Toxic Pollutant Effluent Standards (ref. 10). It is included in the EPA Consent Decree List, Priority III.

National Interim Primary Drinking Water Standards: 0.01 mg/ℓ, as Se (ref. 102).

U.S. Public Health Service Drinking Water Standards, Levels for Source Rejection: 0.01 mg/ℓ, as Se (ref. 66).

EPA 1976 Water Quality Criteria (proposed): For domestic water supply (health)--10 µg/ℓ; for marine and freshwater aquatic life--application factor: 0.01 (to be applied to 96-hr LC_{50}) (ref. 33).

NAS/NAE Water Quality Criteria, 1972: For public water supply sources--0.01 mg/ℓ; for marine aquatic life: hazard level--0.01 mg/ℓ; minimal risk of deleterious effects--0.005 mg/ℓ; application factor--0.01 (to be applied to the 96-hour LC_{50}); for livestock--0.05 mg/ℓ; for irrigation--0.02 mg/ℓ for continuous use on all soils (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 200 µg/m^3

Water, Health: 5 x 10 = 50 µg/ℓ

Land, Health: 0.002 x 50 = 0.1 µg/g

Air, Ecology:

Water, Ecology: 5 x 5 = 25 µg/ℓ

Land, Ecology: 0.002 x 25 = 0.05 µg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.2/420 = 0.5$ µg/m^3

$EPC_{WH1} = 15 \times 0.5 = 7.5$ µg/ℓ

$EPC_{WH2} = 13.8 \times 0.2 = 2.8$ µg/ℓ

$EPC_{WHS} = 10$ µg/ℓ

$EPC_{LH} = 0.002 \times 10 = 0.02$ µg/g

$EPC_{WES} = 5$ µg/ℓ

$EPC_{LE} = 0.002 \times 5 = 0.01$ µg/g

$EPC_{AT} = 10^3/(6 \times 6{,}426) = 0.03$ µg/m^3

$EPC_{WT} = 15 \times 0.03 = 0.45$ µg/ℓ

$EPC_{LT} = 0.002 \times 0.45 = 0.001$ µg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.0E2		0.03		0.004†
Water, $\mu g/l$ (ppm Wt)			5.0E1	2.5E1	10	5	0 - 22 0.45 ‡
Land, $\mu g/g$ (ppm Wt)			1.0E-1	5.0E-2	0.001	0.01	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.5		0.03
Water, $\mu g/l$ (ppm Wt)	10	5			
Land, $\mu g/g$ (ppm Wt)			0.02	0.01	0.001

† For urban atmosphere. No rural concentration is reported.

‡ For seawater

CATEGORY: 54

HYDROGEN SELENIDE: H_2Se (selenium hydride).

Colorless poisonous gas; disagreeable odor of decayed horseradish.

WLN: H2 SE

STRUCTURE:

H_2Se

PROPERTIES:

Molecular wt: 80.98; mp: -60.4; bp: -41.5; gas density: 3.664^{760} (air); vap. press: 10 atm at 23.4° C; solubility (in water: 270 mℓ/100 mℓ at 22.5°.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Hydrogen selenide is formed by the action of dilute acids on metallic selenides. Selenium will combine directly with hydrogen at temperatures below 250° C to form H_2Se. Hydrogen selenide unites directly with most metals to form metal selenides. The odor recognition level for hydrogen selenide is 1.00 mg/m^3 (ref. 3). Hydrogen selenide gas is important as an air contaminant. Because the gas is highly soluble in water, it is also a potential water contaminant.

TOXIC PROPERTIES, HEALTH EFFECTS:

Systemic poisoning as well as pulmonary irritation may result from exposure to hydrogen selenide. Liver damage is reported from exposed experimental animals (ref. 4). It is generally considered to be more toxic than elemental selenium. The lowest toxic dose affecting the central nervous system of a human is 0.2 ppm. See also Selenium and Selenium Compounds.

LC_{50} (inhalation, guinea pig): 1 mg/m^3/8 hr.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.2 mg/m^3 (0.05 ppm).

Standards and criteria applicable to selenium compounds include the following:

Selenium is a candidate for the list for Toxic Pollutant Effluent Standards (ref. 10). It is included in the EPA Consent Decree List, Priority III.

National Interim Primary Drinking Water Standards: 0.01 mg/ℓ, as Se (ref. 102).

U.S. Public Health Service Drinking Water Standards, Levels for Source Rejection: 0.01 mg/ℓ, as Se (ref. 66).

EPA 1976 Water Quality Criteria (proposed): For domestic water supply (health)--10 μg/ℓ; for marine and freshwater aquatic life--application factor: 0.01 (to be applied to 96-hr LC_{50}) (ref. 33).

NAS/NAE Water Quality Criteria, 1972: For public water supply sources--0.01 mg/ℓ for marine aquatic life: hazard level--0.01 mg/ℓ; minimal risk of deleterious effects--0.005 mg/ℓ; application factor--0.01 (to be applied to the 96-hr LC_{50}); for livestock--0.05 mg/ℓ; for irrigation--0.02 mg/ℓ for continuous use on all soils (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 200 μg/m^3 (0.05 ppm)

Water, Health: 5 x 10 = 50 μg/ℓ, as Se

Land, Health: 0.002 x 50 = 0.1 μg/g, as Se

Air, Ecology:

Water, Ecology: 5 x 5 = 25 μg/ℓ, as Se

Land, Ecology: 0.002 x 25 = 0.05 μg/g, as Se

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.2/420 = 0.5$ μg/m^3

$EPC_{AH1a} = 0.05/420 = 0.0001$ ppm

$EPC_{WH1} = 15 \times 0.5 = 7.5$ μg/ℓ

$EPC_{WH2} = 13.8 \times 0.2 = 2.8$ μg/ℓ

$EPC_{WHS} = 10$ μg/ℓ

$EPC_{LH} = 0.002 \times 10 = 0.02$ μg/g

$EPC_{WES} = 5$ μg/ℓ

$EPC_{LE} = 0.002 \times 5 = 0.01$ μg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.0E2 (0.05)		0.5 (0.0001)		
Water, $\mu g/l$ (ppm Wt)			5.0E1	2.5E1	10	5	
Land, $\mu g/g$ (ppm Wt)			1.0E-1	5.0E-2	0.02	0.01	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.5 (0.0001)		
Water, $\mu g/l$ (ppm Wt)	10	5			
Land, $\mu g/g$ (ppm Wt)			0.02	0.01	

CATEGORY: 55

WLN: TE

TELLURIUM AND TELLURIUM COMPOUNDS (AS TELLURIUM):
Te (sylvanium).
Silvery-white, metallic, brittle, and lustrous element; forms rhombic crystals.

STRUCTURE:

Te $Te^{=}$

$TeO_3^{=}$ $TeO_4^{=}$

PROPERTIES:

Atomic number: 52; group 6a; atomic wt: 127.61; mp: 452; bp: 989.9; d: 6.24; vap. press: 1 mm at 520° C; valency: -2, +4, +6 (most common valence state is +4 as $TeO_3^{=}$); insoluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Tellurium, a homolog of sulfur and selenium, is a nonmetal. It ionizes to tellurides and tellurous compounds ($Te^{=}$). Tellurium also forms tellurites ($TeO_3^{=}$) and tellurates and telluric ($TeO_4^{=}$) compounds. Tellurium halides decompose in water.

Occurrence in the Earth's crust is 0.002 ppm (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

Ingestion or inhalation of as little as 40 µg of tellurium in soluble form has caused breath odor. There are no reports of serious illness from industrial exposure to tellurium and its compounds (ref. 14). The unstable gas, hydrogen telluride (H_2Te), is highly toxic, but its presence is unlikely (ref. 40).

Tellurite and tellurate are toxic when fed to rats at concentrations of 25 to 50 ppm (ref. 4).

Tellurium compounds can be absorbed by ingestion, inhalation, or through the skin (ref. 117).

Intoxication causes a garlic odor in breath and perspiration.

LD_{LO} (subcutaneous, dog) 290 mg/kg as tellurium.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.1 mg/m^3.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 100 $\mu g/m^3$	Air, Ecology:
Water, Health: $15 \times 100 = 1.5 \times 10^3$ $\mu g/\ell$	Water, Ecology:
Land, Health: $0.002 \times 1.5 \times 10^3 = 3$ $\mu g/g$	Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.1/420 = 0.24$ $\mu g/m^3$

$EPC_{WH1} = 15 \times 0.24 = 3.6$ $\mu g/\ell$

$EPC_{WH2} = 13.8 \times 0.1 = 1.4$ $\mu g/\ell$

$EPC_{LH} = 0.002 \times 1.4 = 0.003$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E2		0.24		
Water, $\mu g/l$ (ppm Wt)			1.5E3		1.4		
Land, $\mu g/g$ (ppm Wt)			3.0E0		0.003		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.24		
Water, $\mu g/l$ (ppm Wt)			1.4		
Land, $\mu g/g$ (ppm Wt)			0.003		

CATEGORY: 60

WLN: SC

SCANDIUM: Sc.
A silvery-white, soft, light metal.

STRUCTURE:

Sc^{+3}

PROPERTIES:

Atomic number: 21; group 3b; atomic wt: 44.95; valancy: 3;
d: 2.985; mp: 1,538; bp: 2,832.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Scandium occurs in the Earth's crust at 5 to 6 ppm (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

Toxic properties are not established (ref. 9).

LD_{50} (oral, mouse): 4,000 mg/kg for scanadium chloride, $ScCl_3$. This is equivalent to 1,184 mg/kg as Sc.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 45 x 1,184 = 5.3×10^4 μg/m³

Water, Health: 15 x 5.3×10^4 = 8×10^5 μg/ℓ

Land, Health: 0.002 x 8×10^5 = 1.6×10^3 μg/g

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH2} = 0.107 x 1,184 = 127 μg/m³

EPC_{AH3} = 0.081 x 1,184 = 96 μg/m³

EPC_{WH1} = 15 x 96 = 1,440 μg/ℓ

EPC_{WH2} = 0.4 x 1,184 = 474 μg/ℓ

EPC_{LH} = 0.002 x 474 = 0.9 μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, µg/m³ (ppm Vol)			5.3E4		96		
Water, µg/l (ppm Wt)			8.0E5		474		
Land, µg/g (ppm Wt)			1.6E3		0.9		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, µg/m³ (ppm Vol)			96		
Water, µg/l (ppm Wt)			474		
Land, µg/g (ppm Wt)			0.9		

CATEGORY: 62

WLN: TI

TITANIUM AND TITANIUM COMPOUNDS (AS TITANTIUM): Ti.
A dark-gray, amorphous metal.

STRUCTURE:

Ti Ti^{+3} Ti^{+4}

TiO_3^{-2} TiO_4^{-4} TiO^{+2}

PROPERTIES:

Atomic number: 22; group 4b; atomic wt: 47.90; valency: +2, +3, +4; insoluble; mp: 1,677; bp: 3,277; d: 4.506-4.400.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Titanium has +2, +3 and, +4 valence states with +4 being most common. It forms several ions: Titanous ion (Ti^{+3}); Titanic ion (Ti^{+4}); m-Titanate ion ($TiO_3^{=}$); o-Titanate ion (TiO_4^{-4}); Titanyl ion (TiO^{+2}). Titanium halides are decomposed by water; the oxides and hydroxides are insoluble. $Ti_2(SO_4)_3$ is soluble in water.

Rural background concentration in air is 0.003 to 0.15 $\mu g/m^3$ (ref. 1). Natural concentration in seawater is 2 $\mu g/\ell$ (ref. 28).

Titanium is the ninth most abundant element in the Earth's crust, at 0.63 percent by weight (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

Titanium is classified as physiologically inert to humans. Titanium is not reported as an intoxicating agent; titanium oxide dusts are considered nuisances. However, titanium tetrachloride is irritating and corrosive (ref. 9).

LC_{Lo} (inhalation, mouse): 10 mg/m^3 for $TiCl_4$; molecular wt: 189.7

Aquatic toxicity: Titanium is mildly toxic to fish: 96-hr LC_{50} for fathead minnow is 8.2 ppm in soft water for titanium sulfate (ref. 28).

TLm 96 (for titanium tetrachloride): 1,000 to 100 ppm (ref. 2).

Titanium is effectively excluded by plants (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV for titanium dioxide, classified as a nuisance particulate: 10 mg/m^3, molecular wt: TiO_2: 79.9 as Ti: 47.9/79.9 x 10 = 6 mg/m^3 (except $TiCl_4$).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 6×10^3 $\mu g/m^3$ (except as $TiCl_4$)
Water, Health: $15 \times 6 \times 10^3 = 9 \times 10^4$ $\mu g/\ell$
Land, Health: $0.002 \times 9 \times 10^4 = 180$ $\mu g/g$

Air, Ecology:
Water, Ecology: $100 \times 8.2 = 820$ $\mu g/\ell$, as $Ti(SO_4)_2$
Land, Ecology: $0.002 \times 820 = 1.6$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 6/420 = 14$ $\mu g/m^3$, as Ti (except $TiCl_4$)
$EPC_{WH1} = 15 \times 14 = 210$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 6 = 83$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 83 = 0.17$ $\mu g/g$

$EPC_{WE1} = 50 \times 82 = 4,100$ $\mu g/\ell$, as $Ti(SO_4)_2$
$EPC_{LE} = 0.002 \times 4,100 = 8$ $\mu g/g$, as $Ti(SO_4)_2$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			6.0E3		14		0.003 - 0.15
Water, $\mu g/l$ (ppm Wt)			9.0E4	8.2E2	83	4,100	2 †
Land, $\mu g/g$ (ppm Wt)			1.8E2	1.6E0	0.17	8	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			14		
Water, $\mu g/l$ (ppm Wt)			83	4,100	
Land, $\mu g/g$ (ppm Wt)			0.17	8	

† For seawater

CATEGORY:65

WLN: V

VANADIUM, V.
Light gray or white powder, lumps, or crystals.

STRUCTURE:

V V^{+2} V^{+3}

VO^{+} VO_4^{-3} VO_3^{-2} VO^{+3}

PROPERTIES:

Atomic number: 23; group 5b; atomic weight: 50.94; valency: 2, 3, 4, 5; mp: 1,917; bp: 3,000; d: 6.11; insoluble; vap. press: 10 mm at 12.2° C (for vanadyl trichloride, $VOCl_3$).

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Vanadium assumes several series of compounds: Vanadous (V^{++}); Vanadic (V^{+3}), Vanadyl(ous) (VO^{+}); orthovanadate (VO_4^{-3}); Metavanadate ($VO_3^{=}$); Vanadyl(ic) (VO^{+3}). The +5 valence state is more common. Vanadates are salts of Vanadic acid, HVO_3.

Vanadium is present in the Earth's crust at 0.01 percent by weight (ref. 24). Vanadium concentrated by certain organisms during the formation of oil-bearing strata in geological time is present in coal and oil (ref. 28).

Vanadium is a common air contaminant; it enters the atmosphere through combustion of fossil fuels, particularly oil (ref. 38). Rural background concentrations measured in air range from 0.005 to 0.024 $\mu g/m^3$ (ref. 1). The natural concentration of vanadium in seawater is 2 $\mu g/\ell$ (ref. 28). It has been found in U.S. surface waters in concentrations up to 0.3 mg/ℓ; most samples however, are less than 0.05 mg/ℓ (ref. 28).

TOXIC PROPERTIES, HEALTH EFFECTS:

Vanadium is toxic by all routes of administration, with the pentavalent compounds exhibiting the highest degree of toxicity. Inhalation causes respiratory system effects, including tracheitis, bronchitis, pulmonary edema, and bronchial pneumonia. Dermatitis and conjunctivitis may also occur. Workers exposed to 0.5 to 2.2 mg/m^3 of V_2O_5 had eye and bronchial irritation; 0.2 to 0.5 mg/m^3 has caused respiratory symptoms (ref. 4). Eye effects are reported at 100 $\mu g/m^3$ (ref. 2). Chronic effects have not been reported (ref. 9).

LD_{50} (oral, mouse): 23 mg/kg for vanadium pentoxide.

In air, 0.5 to 1.0 $\mu g/m^3$ produced noticeable effects to plants (ref. 25). Flax, soybeans, and peas showed toxicity to vanadium at 0.5 to 2.5 mg/ℓ in nutrient solutions (ref. 28).

Aquatic toxicity: 96-hour LC_{50}: 4.8 ppm for fathead minnow, Pimephales promelas (as vanadyl sulfate) (ref. 28) or 1.5 ppm, as V.

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (V_2O_5): dust, 0.5 mg/m^3, as V.
fume, 0.05 mg/m^3, as V.

NAS/NAE 1972 Water Quality Criteria: For marine aquatic life--application factor of 0.05 (to be applied to 96-hour LC_{50}); for livestock--0.1 mg/ℓ; for irrigation--0.10 mg/ℓ for continuous use on all soils (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 500 $\mu g/m^3$
Water, Health: $15 \times 500 = 2.5 \times 10^3$ $\mu g/\ell$
Land, Health: $0.002 \times 2.5 \times 10^3 = 5$ $\mu g/g$

Air, Ecology: 1.0 $\mu g/m^3$
Water, Ecology: $100 \times 1.5 = 150$ $\mu g/\ell$
Land, Ecology: $0.002 \times 150 = 0.3$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.5/420 = 1.2$ $\mu g/m^3$
$EPC_{WH1} = 15 \times 1.2 = 18$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 0.5 = 7$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 7 = 0.014$ $\mu g/g$

$EPC_{AE} = 0.1 \times 1.0 = 0.1$ $\mu g/m^3$
$EPC_{WE1} = 50 \times 1.5 = 75$ $\mu g/\ell$
$EPC_{WES} = 0.05 \times 1500 = 75$ $\mu g/\ell$
$EPC_{LE} = 0.002 \times 75 = 0.15$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.0E2	1.0E0	1.2	0.1	0.005-0.024
Water, $\mu g/l$ (ppm Wt)			2.5E3	1.5E2	7	75	<50
Land, $\mu g/g$ (ppm Wt)			5.0E0	3.0E-1	0.014	0.15	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			1.2	0.1	
Water, $\mu g/l$ (ppm Wt)		75	7		
Land, $\mu g/g$ (ppm Wt)			0.014	0.15	

CATEGORY: 68

CHROMIUM AND CHROMIUM COMPOUNDS (AS CHROMIUM): Cr.

Very hard metal; cubic blue-white crystals. Chromium compounds are highly colored.

PROPERTIES:

Atomic no: 24; group 6: atomic wt: 51.996; mp: 1,890; bp: 2,642; d: 7.20; vap. press: 1 mm at 1,616° C; valency: 3,2,6.

WLN:

STRUCTURE:

Cr^{+2}	CrO_2^-
Cr^{+3}	CrO_2^{++}
$CrO_4^=$	$Cr_2O_7^=$

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Chromium occurs principally as chromites (CrO_2^-). Other compounds include chromous (Cr^{+2}), chromic (Cr^{+3}), and hexavalent chromium as chromyl (CrO_2^{+2}). Chromates ($CrO_4^=$) and dichromates ($Cr_2O_7^=$) may also occur. The concentration of Cr in rural atmosphere is reported as 0.012 to 0.001 $\mu g/m^3$ (ref. 1). Concentration of hexavelent chromium as indicated from hydrologic benchmark samples ranges from zero to 30 $\mu g/\ell$; out of nine samples, four were 0 (ref. 64). Seawater concentration of chromium is reported as about 0.04 $\mu g/\ell$ (refs. 28,69). The trivalent form is not likely to be present in waters of pH5 or above because of the very low solubility of the hydrated oxide.

Chromium occurs in the Earth's crust at 100 to 300 ppm (ref. 24). Concentration in soil averages about 40 ppm (ref. 126).

TOXIC PROPERTIES, HEALTH EFFECTS:

All chromium compounds are considered poisonous. There is some indication that under long-term exposure, trivalent and hexavalent forms may exhibit similar toxicities. Hexavalent chromium is generally considered more hazardous than trivalent chromium. Exposure to chromium in air results in injury to nasal tissues of exposed workers. Other respiratory problems also result, involving cancer of the respiratory tract (associated with exposure to high concentrations) (ref. 4). Inhalation of 4,500 $\mu g/m^3$ chromium for 5 years has resulted in pulmonary effects in humans (ref. 2).

LD_{50} (oral, rat): 1,870 mg/kg, for $CrCl_3$. This is equivalent to 615 mg/kg as Cr^{+3}.

There is an excessive risk of lung cancer among workers in the chromate-producing industry (ref. 91). Cancer in a human has resulted from exposure to 110 $\mu g/m^3$ of CrO_3 (ref. 27). Duration of exposure is not reported. Chromium and numerous chromium compounds are reported to cause cancer in rats and in mice (refs. 2,91). EPA/NIOSH ordering number is 7327. The lowest dosage resulting in a carcinogenic response is 1 mg/kg. The adjusted ordering number is 7327.

Aquatic toxicity: Chromium is toxic to aquatic life, the most sensitive marine species being the oyster; 10 to 12 $\mu g/\ell$ may be lethal to oysters (ref. 28). Chromium exhibits a biocumulative effect in aquatic organisms; some phytoplankton can accumulate 2,300 times the concentration in water (ref. 28).

Chromium concentrations of 0.5 mg/ℓ in water solutions and 10 mg/kg in soil cultures reduced soybean yields (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV: 0.1 mg/m^3 for chromic acid and chromates, as CrO_3 (or 0.05 mg/m^3, as Cr^{+6})
0.5 mg/m^3 for chromium and insoluble chromic chromous salts, as Cr.

ACGIH lists certain insoluble chromates as human carcinogens. TLV for these compounds is not specified. Chromates are included in the National Cancer Institute List of Carcinogens to Man.

On EPA Consent Decree Priority I List and Candidate for list for Toxic Pollutant Effluent Standards (ref. 10).

Interim Primary Drinking Water Standards: 0.05 mg/ℓ, as chromium (ref. 102).

U.S. Public Health Service Drinking Water Regulations, Levels for Source Rejection: 0.05 mg/ℓ, as Cr^{+6} (ref. 66).

NAS/NAE 1972 Water Quality Criteria, for chromium: For public water supply sources: 0.05 mg/ℓ; for freshwater aquatic life: 0.05 mg/ℓ; for marine aquatic life: hazard level--0.1 mg/ℓ; minimal risk of deleterious effects--0.05 mg/ℓ (0.01 mg/ℓ for oyster areas); application factor--0.01 (to be applied to the 96-hour LC_{50}); for irrigation: 0.1 mg/ℓ for continuous use on all soils (ref. 28).

Chromium (VI) is the subject of a NIOSH Criteria Document. The NIOSH recommendation for occupational exposure, considering potential carcinogenicity of Cr^{+6}, is 1 $\mu g/m^3$ (ref. 127).

EPA 1976 Water Quality Criteria (proposed): For domestic water supply (health): 50 $\mu g/\ell$; for freshwater aquatic life: 100 $\mu g/\ell$ (ref. 33).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1 $\mu g/m^3$	Air, Ecology:
Water, Health: 5 x 50 = 250 $\mu g/\ell$	Water, Ecology: 5 x 50 = 250 $\mu g/\ell$
Land, Health: 0.002 x 250 = 0.5 $\mu g/g$	Land, Ecology: 0.002 x 250 = 0.5 $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.05/420 = 0.12\ \mu g/m^3$

$EPC_{WH1} = 15 \times 0.12 = 1.8\ \mu g/\ell$

$EPC_{WH2} = 13.8 \times 0.05 = 0.7\ \mu g/\ell$

$EPC_{WHS} = 50\ \mu g/\ell$

$EPC_{LH} = 0.002 \times 50 = 0.1\ \mu g/\ell$

$EPC_{AC1} = 1/420 = 0.002\ \mu g/m^3$

$EPC_{AC2} = 10^3/(6 \times 7327) = 0.02\ \mu g/m^3$

$EPC_{WC} = 15 \times 0.002 = 0.03\ \mu g/\ell$

$EPC_{LC} = 0.002 \times 0.03 = 0.0001\ \mu g/g$

$EPC_{WES} = 50\ \mu g/\ell$

$EPC_{WES} = 10\ \mu g/\ell$ (for oyster areas)

$EPC_{LE} = 0.002 \times 50 = 0.1\ \mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E0		0.002		0.012-0.001
Water, $\mu g/l$ (ppm Wt)			2.5E2	2.5E2	50	50 10 †	0 - 30, 0.04 ‡
Land, $\mu g/g$ (ppm Wt)			5.0E-1	5.0E-1	0.0001	0.1	40

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.12		0.002
Water, $\mu g/l$ (ppm Wt)	50	50, 10 †			
Land, $\mu g/g$ (ppm Wt)			0.1	0.1	0.0001

† For oyster areas

‡ For seawater

CATEGORY: 69

WLN: MO

MOLYBDENUM AND MOLYBDENUM COMPOUNDS (AS MOLYBDENUM): Mo.
Cubic, silver-white, metallic crystals or gray-black powder.

STRUCTURE:

$Mo \quad Mo^{=} \quad Mo^{+3} \quad Mo^{+6}$

$M_2MoO_4 \quad M_2Mo_2O_7$

(M is a monovalent metal.)

PROPERTIES:

Atomic number: 42; group 6b; atomic wt: 95.94; mp: 2,617; bp: 4,825; d: 10.28; vap. press: 1 mm at 3,102; valency: -2, 3, 4, 5, 6; insoluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Molybdenum is a heavy metal of the chromium group. Most molybdenum compounds are derived from molybdenous ($Mo^{=}$), molybdic (Mo^{+3} or Mo^{+6}), and molybdate ($MoO_4^{=}$ or $Mo_2O_7^{=}$). The rural background concentration for molybdenum in air is reported as 0.001 to 0.0032 μg/ℓ (ref. 1). Natural concentration in seawater is 10 μg/ℓ (ref. 28). Occurrence in the Earth's crust is 1 to 1.5 ppm (ref. 24). Molybdenum is an essential trace element in plant nutrition. An average concentration of 2 μg/g in soils is reported (ref. 128).

TOXIC PROPERTIES, HEALTH EFFECTS:

Molybdenum compounds exhibit a low order of toxicity for exposed workers (ref. 4). Molybdenum trioxide and ammonium molybdate are more toxic than the metal or the dioxide (ref. 4). Signs of molybdenum poisoning are loss of appetite, listlessness, diarrhea, and reduced growth rate (ref. 96).

LD_{50} (intraperitoneal, mouse): 160 mg/kg.

There is an interrelation between molybdenum and copper in the nutrition requirements for sheep and cattle. Copper poisoning is associated with low molybdenum levels in forage; copper starvation is associated with high molybdenum levels (ref. 98). Molybdosis of cattle was associated with alsike clover grown in soils that had 0.01 to 0.10 mg/ℓ of molybdenum in saturation extracts (ref. 28).

Phytotoxicity is negligible, but plants accumulate molybdenum in proportion to the amount in the soil (ref. 28).

Aquatic toxicity: Marine molluscs are reported to have a concentration factor of 60 times the concentration in water (ref. 28). 96-hr LC_{50} for fathead minnow, _Pimephales promelas_, is 70 mg/ℓ (for molybdic anhydride).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (soluble compounds): 5 mg/m^3.
(insoluble compounds): 10 mg/m^3.

NAS/NAE 1972 Water Quality Criteria: For marine aquatic life: 24-hr average--0.02 times 96-hr LC_{50}; for irrigation--0.010 mg/ℓ for continuous use on all soils (based on animal toxicities from forage) (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 5×10^3 μg/m^3
Water, Health: $15 \times 5 \times 10^3 = 7.5 \times 10^4$ μg/ℓ
Land, Health: $0.002 \times 7.5 \times 10^4 = 150$ μg/g

Air, Ecology:
Water, Ecology: $100 \times 70 = 7 \times 10^3$ μg/ℓ
Land, Ecology: $0.002 \times 7 \times 10^3 = 14$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 5/420 = 12$ μg/m^3
$EPC_{WH1} = 15 \times 12 = 180$ μg/ℓ
$EPC_{WH2} = 13.8 \times 5 = 70$ μg/ℓ

$EPC_{LH} = 0.002 \times 70 = 0.14$ μg/g

$EPC_{WE1} = 50 \times 70 = 3{,}500$ μg/ℓ
$EPC_{WE3} = 20 \times 70 = 1{,}400$ μg/ℓ
$EPC_{WES} = 10$ μg/ℓ (for irrigation)
$EPC_{LE} = 0.002 \times 10 = 0.02$ μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.0E3		12		0.001-0.0032
Water, $\mu g/l$ (ppm Wt)			7.5E4	7.0E3	70	1,400 10 †	10 ‡
Land, $\mu g/g$ (ppm Wt)			1.5E2	1.4E1	0.14	0.02	2

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			12		
Water, $\mu g/l$ (ppm Wt)		10 †	70	1,400	
Land, $\mu g/g$ (ppm Wt)			0.14	0.02	

† For irrigation

‡ For seawater

CATEGORY: 70

WLN: .WO

TUNGSTEN AND TUNGSTEN COMPOUNDS (AS TUNGSTEN): W (wolfram). A steely gray to white, cuttable, forgeable, and spinnable metal.

STRUCTURE:

W	W^{+6}	W^{+2}
W^{+4}	W^{+5}	W^{+6}

PROPERTIES:

Atomic number: 74; group 6b; atomic wt: 183.85; mp: 3,410; bp: 5,930; d: 19.3; valency: +2, +3, +4, +5, and +6; insoluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Tungsten forms compounds of several oxidation states. The most stable and most common valence state is +6, and such compounds are acidic. Tungsten oxides are insoluble. Tungsten hexachloride and tungsten trisulfide are slightly soluble in water.

Occurrence in the Earth's crust is about 1.5 ppm (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

The toxicity associated with tungsten is greatly effected by the solubility of the specific tungsten compound present, with the soluble compounds exhibiting the greater degree of toxicity. Tungsten is generally considered to be more toxic than molybdenum; however, certain tungsten compounds, such as tungsten carbide, are biologically inert. No serious toxic effects are associated with tungsten.

LD_{50} (intraperitoneal, rat): 5,000 mg/kg.

Tungsten is effectively excluded by plants; phytotoxicity is not a problem (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (Tungsten and compounds, as W) soluble: 1 mg/m^3; insoluble: 5 mg/m^3.

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 1.0×10^3 $\mu g/m^3$

Water, Health: $15 \times 1.0 \times 10^3 = 1.5 \times 10^4$ $\mu g/\ell$

Land, Health: $0.002 \times 1.5 \times 10^4 = 30$ $\mu g/g$

Air, Ecology:

Water, Ecology:

Land, Ecology:

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 1/420 = 2.4$ $\mu g/m^3$

$EPC_{WH1} = 15 \times 2.4 = 36$ $\mu g/\ell$

$EPC_{WH2} = 13.8 \times 1 = 14$ $\mu g/\ell$

$EPC_{LH} = 0.002 \times 14 = 0.03$ $\mu g/g$

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E3		2.4		
Water, $\mu g/l$ (ppm Wt)			1.5E4		14		
Land, $\mu g/g$ (ppm Wt)			3.0E1		0.03		

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			2.4		
Water, $\mu g/l$ (ppm Wt)			14		
Land, $\mu g/g$ (ppm Wt)			0.03		

CATEGORY: 71

WLN: MN

MANGANESE AND MANGANESE COMPOUNDS (AS MANGANESE): Mn (colloidal manganese).
Reddish-gray or silvery, hard, brittle, metallic element.

STRUCTURE:

Mn $\quad Mn^{++}$ $\quad Mn^{+3}$

$MnO_3^{=}$ $\quad MnO_4$ $\quad MnO_4^{-}$

PROPERTIES:

Atomic number: 25; group 7b: atomic wt.: 54.938; mp: 1,244 ± 3; bp: 1,962; vap. press: 1 mm at 1292° C; valency: 2, 3, 4, 6, 7; decomposes water, evolving H_2.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Manganese exhibits five valence states, the divalent manganous (M^{++}) being the most common. Manganic (Mn^{+3}) and manganite compounds ($MnO_3^{=}$) are less common than manganates ($MnO_4^{=}$) or permanganates (MnO_4^{-}).

Rural background concentration of manganese in air is reported as 0.005 to 0.047 μg/m³ (ref. 1). Manganese occurs as a constituent of gross suspended particles ranging from 0.005 to 0.012 μg/m³ in nonurban atmosphere (ref. 3). Manganese compounds may act as catalysts in the oxidation of some air pollutants, producing even more undesirable pollutants (ref. 129). Natural concentration in seawater is 2 μg/ℓ (ref. 28). In an analysis of U.S. surface waters, the manganese concentration mean was 29.4 μg/ℓ with a range of 0.20 to 3,230 μg/ℓ (ref. 28). Manganese is a trace element in food, with the average human intake being 10 mg/day (ref. 33). Manganese is considered an essential trace element for animals, including man, and plants (ref. 130). Occurrence in the Earth's crust is 0.085 percent (ref. 24). Soils have an average manganese content of 800 to 850 μg/g. Manganese in the soil is found in a water-soluble form in the soil solution, in the exchangeable Mn^{2+} as organically bound manganese, and as various manganese oxides (ref. 28).

TOXIC PROPERTIES, HEALTH EFFECTS:

Manganese compounds are not in general regarded as highly poisonous due to the manganous ion alone (ref. 130). The strong oxidizing properties of manganates and permanganates can cause skin irritation. Respiratory damage may also occur with exposure. Chronic poisoning may result from inhalation of manganese or its compounds (ref. 129). The lowest concentration causing toxic effects in human is reported to be 11 mg/m³; exposure was by inhalation and resulted in central nervous system effects (ref. 2).

LD_{50} (intraperitoneal, mouse): 53 mg/kg.

Aquatic toxicity: Bioaccumulation factors of 12,000 are reported for marine molluscs (ref. 33). An acute dose 96-hr LC_{50} of 1,400 ppm is reported for rainbow trout (Salmo gairdneri), carp, (Cyprinus carpio), and Daphnia (ref. 24).

Soil concentrations of 2.5 ppm have caused their effects in soybeans; soil effects, however, depend on a variety of factors such as pH and moisture (ref. 131).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (manganese and compounds, as Mn): 5 mg/m³.

U.S. Public Health Service Drinking Water Regulations, 1962, Levels for Alternate Source Selection: 0.05 μg/ℓ manganese (ref. 66).

EPA 1976 Water Quality Criteria (proposed): For domestic water supplies (welfare): 50 μg/ℓ; for protection of consumers of marine molluscs: 100 μg/ℓ (ref. 33).

NAS/NAE 1972 Water Quality Criteria: For public water sources: 0.05 mg/ℓ; for marine aquatic life: hazard level--0.1 mg/ℓ; minimal risk of deleterious effects--0.02 mg/ℓ; application factor--0.02 (to be applied to 96-hr LC_{50}; for irrigation--0.20 mg/ℓ for continuous use on all soils (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 5×10^3 μg/m³

Water, Health: 5 x 50 = 250 μg/ℓ

Land, Health: 0.002 x 250 = 0.5 μg/g

Air, Ecology:

Water, Ecology: 5 x 20 = 100 μg/ℓ

Land, Ecology: 0.002 x 100 = 0.2 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 5/420 = 12$ μg/m³

$EPC_{WH1} = 15 \times 12 = 180$ μg/ℓ

$EPC_{WH2} = 13.8 \times 5 = 70$ μg/ℓ

$EPC_{WHS} = 50$ μg/ℓ

$EPC_{LH} = 0.002 \times 50 = 0.1$ μg/g

WES = 20 μg/ℓ

LE = 0.002 x 20 = 0.04 μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.0E3		12		0.005-0.047
Water, $\mu g/l$ (ppm Wt)			2.5E2	1.0E2	50	20	29.4 2†
Land, $\mu g/g$ (ppm Wt)			5.0E-1	2.0E-1	0.1	0.04	800-850

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			12		
Water, $\mu g/l$ (ppm Wt)	50	20			
Land, $\mu g/g$ (ppm Wt)			0.1	0.04	

†For seawater.

CATEGORY: 74

COBALT AND COBALT COMPOUNDS (AS COBALT), Co

A magnetic, steel-gray, pinkish, ductile metal.

WLN: CO

STRUCTURE:

Co Co^{+2} Co^{+3}

PROPERTIES:

Atomic number: 27; group 8; atomic wt: 58.93;
bp: 2,900; mp: 1,495; d: 8.92; insoluble;
valency: 1,2,3.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Cobalt is an element of the iron group. It forms two series of compounds: Cobaltous (valence +2) and cobaltic (+3), the cobaltous form being more stable.

Rural background concentration measured in air is reported as zero $\mu g/m^3$ to 0.002 $\mu g/m^3$ (ref. 1). Natural concentration in seawater is 0.4 $\mu g/\ell$ (ref. 28). Concentration in freshwater as indicated from a survey of U.S. surface waters from zero to 5 $\mu g/\ell$ with a mean of 1.0 $\mu g/\ell$ (ref. 28). Occurrence in earth's crust is 0.001 - 0.002 percent (ref. 24). Average soil concentration is reported as 8 $\mu g/g$ (ref. 128). Cobalt is an essential trace element, and is associated with vitamin B_{12} in animals (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

Some pulmonary effects, an allergic-type dermititis, digestive changes, and liver and kidney damage resulting from exposure to cobalt and its compounds have been reported (refs. 4,9). Cobalt and its salts are cumulative (ref. 96).

LD_{Lo} (oral, rat): 1,500 mg/kg, for cobalt.

LD_{50} (oral, rat): 80 mg/kg, for $CoCl_2$; this is equivalent to 36 mg/kg as Co^{+2}. Ingestion of 1,500 mg/kg of $CoCl_2$ has caused death to a child (ref. 2).

Cobalt and cobalt nitrate, oxide and sulfide are reported to produce oncogenic effects in animals (ref. 2). The EPA/NIOSH ordering number, considering the cobalt compounds collectively is 4204. The lowest TD_{Lo} is 2.5 mg/kg as Co. The adjusted ordering number is 1682.

Aquatic toxicity: Concentrations as low as 0.05 mg/ℓ inhibited growth in small carp, _Cyprinus carpio_ (ref. 28). At 0.04 mg/ℓ, cobalt retarded growth in _Chlorella_ (algae) and _Euglena_ (ref. 132). Cobalt is cumulative in several aquatic species: concentration factors as high as 2.5×10^5 are reported (ref. 28).

Phytotoxicity: At 0.1 mg/ℓ , cobalt is toxic to tomato plants (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (Cobalt metal fume and dust): 0.1 mg/m^3 [Intended change to 0.05 mg/m^3, recognizing potential hypersensitivity of some individuals and associated pulmonary effects.]

NAS/NAE 1972 Water Quality Criteria: For livestock: 1 mg/ℓ; for irrigation: 0.050 mg/ℓ for continuous use on all soils (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 50 $\mu g/m^3$
Water, Health: $15 \times 50 = 750$ $\mu g/\ell$
Land, Health: $0.002 \times 750 = 1.5$ $\mu g/g$

Air, Ecology:
Water, Ecology: $5 \times 50 = 250$ $\mu g/\ell$
Land, Ecology: $0.002 \times 250 = 0.5$ $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.05/420 = 0.12$ $\mu g/m^3$
$EPC_{WH1} = 15 \times 0.12 = 1.8$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 0.05 = 0.7$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 0.7 = 0.001$ $\mu g/g$
$EPC_{AC2} = 10^3/(6 \times 1682) = 0.1$ $\mu g/m^3$
$EPC_{WC} = 15 \times 0.1 = 1.5$ $\mu g/m^3$
$EPC_{LC} = 0.002 \times 1.5 = 0.003$ $\mu g/g$

$EPC_{WES} = 50$ $\mu g/\ell$ (for irrigation)
$EPC_{LE} = 0.002 \times 50 = 0.1$ $\mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.0E1		0.1		0 to 0.002
Water, $\mu g/l$ (ppm Wt)			7.5E2	2.5E2	0.7	50	0.4†
Land, $\mu g/g$ (ppm Wt)			1.5E0	5.0E-1	0.001	0.1	8

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.12		0.1
Water, $\mu g/l$ (ppm Wt)		50‡	0.7		1.5
Land, $\mu g/g$ (ppm Wt)			0.001	0.1	0.003

†For seawater.
‡For irrigation.

CATEGORY: 76

WLN: NI

NICKEL AND NICKEL COMPOUNDS (AS NICKEL), Ni

STRUCTURE:

A silvery-white, hard metal.

Ni Ni^{+2}

PROPERTIES: Atomic number: 28; group 8; atomic wt: 58.71; mp: 1453; bp: 2732; d: 8.90; vap. press: 1 mm at 1810°; valency: -1,0,+1,+2,+3,+4; insoluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Nickel is similar to iron and cobalt as well as copper in its chemical properties. The metal oxide is extremely resistant to alkali such as NaOH even at high temperatures. The nickel atom assumes several oxidation states; nickelous compounds, valence +2; are the most common. Anhydrous nickelous salts are yellow; hydrous salts are green. An important zero valence nickel compound is nickel carbonyl.

Concentrations of nickel in rural atmosphere are reported ranging from 0.0006 to 0.021 μg/m³ (ref. 1). Nickel has been measured as 0.01 percent of gross suspended particulate in nonurban atmosphere (ref. 3). The concentration of dissolved nickel in natural freshwaters ranges from 3 to 86 μg/ℓ; suspended nickel ranges from 5 to 900 μg/ℓ (ref. 33).

Natural concentration of nickel in seawater is 5 to 7 μg/ℓ (refs. 28,33,69).

Soil background concentrations range 20-2000 kg/hectare, a typical level being 80 kg/hectare (ref. 118). Occurrence in the earth's crust is 0.018 percent (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

The presence of nickel in plant and animal tissues results in a considerable dietary intake which is not harmful. Workers exposed to nickel may develop a sensitivity to nickel and dermatitis. Nickel salts are recognized to be highly toxic following access to the bloodstream in laboratory animals (ref. 96).

Nickel absorbed through inhalation may be associated with nasal, sinus, and lung cancer (ref. 4). According to the International Agency for Research on Cancer, it is probable that nickel in some form is carcinogenic to humans (refs. 91, 133). The EPA/NIOSH ordering number considering nickel and its compounds collectively is 7629. The lowest dosage resulting in an oncogenic response is 16 mg/kg, as Ni. The adjusted ordering number is 477.

Aquatic toxicity: 96-hour LC_{50}: 0.8 mg/ℓ as $Ni(NO_3)_2$ for stickleback (ref. 28). This is equivalent to 0.26 mg/ℓ as Ni^{+2}. Data indicate that nickel concentrations >100 μg/ℓ may adversely effect several aquatic species (ref. 33).

Concentrations of 0.5 to 1.0 mg/ℓ (Ni^{++}) are toxic to tomato, oats, and other plants in sand and solution culture (ref. 28).

Nickel salts are reported to substantially affect the biological oxidation of sewage (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV=0.1 mg/m³, soluble compounds, as Ni. Nickel sulfide roasting is recognized by ACGIH as an industrial process having carcinogenic potential. A TLV of 1.0 mg/m³ is tentative. The new NIOSH recommendation for occupational exposure to nickel is 15 μg/m³. The value was lowered due to evidence of nasal and lung cancer resulting from nickel exposure (ref. 134). Nickel is included in the NCI list of carcinogens to man.

Nickel is a candidate for the list for Toxic Pollutant Effluent Standards (ref. 10). It is listed as Priority I on the EPA Consent Decree List.

EPA 1976 Water Quality Criteria (proposed): 0.01 of the 96-hour LC_{50} for freshwater and marine aquatic life (ref. 33).

NAS/NAE 1972 Water Quality Criteria: For freshwater aquatic life: application factor--0.02 (to be applied to 96-hour LC_{50}): for marine aquatic life: hazard level--0.1 mg/ℓ; minimal risk level--0.002 mg/ℓ; application factor--0.02 (to be applied to 96-hour LC_{50}); for irrigation: 0.2 mg/ℓ, for continuous use on all soils (ref. 28).

Recommendation of U.S. Department of Agriculture and Land Grant Institutions: nickel concentration for most soils--100 kg/hectare (ref. 112).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 15 μg/m³
Water, Health: 15 x 15 = 225 μg/ℓ
Land, Health: 0.002 x 225 = 0.45 μg/g

Air, Ecology:
Water, Ecology: 5 x 2 = 10 μg/ℓ
Land, Ecology: 0.002 x 10 = 0.02 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.1/420 = 0.24$ μg/m³
$EPC_{WH1} = 15 \times 0.24 = 3.6$ μg/ℓ
$EPC_{WH2} = 13.8 \times 0.1 = 1.4$ μg/ℓ
$EPC_{LH} = 0.002 \times 1.4 = 0.003$ μg/g
$EPC_{AC1} = 10^3 \times 0.015/420 = 0.04$ μg/m³
$EPC_{AC2}{}^* = 10^3/(6 \times 477) = 0.3$ μg/m³
$EPC_{WC} = 15 \times 0.04 = 0.6$ μg/ℓ
$EPC_{LC} = 0.002 \times 0.6 = 0.001$ μg/g

$EPC_{WES} = 2$ μg/ℓ
$EPC_{LE} = 0.002 \times 2 = 0.004$ μg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.5E1		0.035		0.0006 - 0.021
Water, $\mu g/l$ (ppm Wt)			2.3E2	1.0E1	0.6	2	3 - 86, 5 - 7 †
Land, $\mu g/g$ (ppm Wt)			4.5E-1	2E-2	0.001	0.004	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.24		0.04
Water, $\mu g/l$ (ppm Wt)		2	1.4		0.6
Land, $\mu g/g$ (ppm Wt)			0.003	0.004	0.001

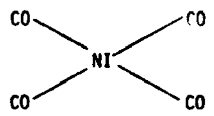
† For seawater

CATEGORY: 76

WLN: OC 4 - NI -

NICKEL CARBONYL, $Ni(CO)_4$ (Nickel tetracarbonyl).
A colorless, mobile, volatile, liquid.

STRUCTURE:



PROPERTIES:
Molecular wt: 170.75; bp: 43; mp: -25; d: 1.32 at 17°; vap. press: 320.6 mm at 20°; solubility 0.018 g per 100 ml H_2O; % Nickel: 34.7.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Nickel carbonyl is a zerovalent nickel compound. It forms by the reaction of CO on finely divided nickel at 200° C and 100-400 atmospheres. Decomposition of nickel carbonyl results in liberation of carbon monoxide and pure nickel.

Nickel carbonyl has a characteristic odor that is detectable at 1-3 ppm (ref. 96).

See Nickel and Nickel Compounds, as Ni.

TOXIC PROPERTIES, HEALTH EFFECTS:

Nickel carbonyl is extremely toxic. The primary effect of acute poisoning is pneumonitus. Inhalation is the most serious absorption route. Toxic symptoms probably are caused by both the nickel and carbon monoxide liberated in the lungs (ref. 9). The lowest reported concentration lethal to a person is 57 ppm for 30 minutes (ref. 2). Chronic exposure has been associated with cancer of the lung and nasal sinuses (ref. 4).

LC_{50} (inhalation, rat): 240 mg/m^3 for 30 minutes.

Nickel carbonyl administered intravenously and via inhalation is reported to produce cancer in rats (refs. 2,133). The EPA/NIOSH ordering number is 4121. The lowest toxic dose producing a carcinogenic response is 157 mg/kg. The adjusted ordering number is 26.

Aquatic toxicity: TLm96: 100-10 ppm (ref. 2).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.35 mg/m^3 (0.05 ppm) [Earlier TLV of 0.007 mg/m^3 (0.001 ppm) was raised due to lack of substantial evidence that the compound is carcinogenic.]

The following regulations pertain to nickel and its compounds, as Ni.

The new NIOSH recommendation for occupational exposure to nickel is 15 $\mu g/m^3$. The value was lowered due to evidence of nasal and lung cancer resulting from nickel exposure (ref. 134). 43 $\mu g/m^3$ $Ni(CO)_4$ is equivalent to 15 $\mu g/m^3$ as Ni.

Nickel is included in the NCI list of carcinogens to man.

Nickel is a candidate for the list for Toxic Pollutant Effluent Standards (ref. 10). It is listed as Priority I on the EPA Consent Decree List.

EPA 1976 Water Quality Criteria (proposed): 0.01 of the 96-hour LC_{50} for freshwater and marine aquatic life (ref. 33).

NAS/NAE 1972 Water Quality Criteria: For freshwater aquatic life: application factor--0.02 (to be applied to 96-hour LC_{50}); for marine aquatic life: hazard level--0.1 mg/ℓ; minimal risk level--0.002 mg/ℓ; application factor--0.02 (to be applied to 96-hour LC_{50}); for irrigation: 0.2 mg/ℓ for continuous use on all soils (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 43 $\mu g/m^3$
Water, Health: 15 x 43 = 645 μg/ℓ
Land, Health: 0.002 x 645 = 1.3 μg/g

Air, Ecology:
Water, Ecology: 5 x 2 = 10 μg/ℓ, as Ni
Land, Ecology: 0.002 x 10 = 0.02 μg/g, as Ni

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.35/420 = 0.8\ \mu g/m^3$
$EPC_{AH1a} = 0.05/420 = 0.0001$ ppm
$EPC_{WH1} = 15 \times 0.8 = 12\ \mu g/\ell$
$EPC_{WH2} = 13.8 \times 0.35 = 5\ \mu g/\ell$
$EPC_{LH} = 0.002 \times 5 = 0.01\ \mu g/g$
$EPC_{AC1} = 43/420 = 0.1\ \mu g/m^3$
$EPC_{AC2} = 10^3/(6 \times 26) = 6.4\ \mu g/m^3$
$EPC_{WC} = 15 \times 0.1 = 1.5\ \mu g/\ell$
$EPC_{LC} = 0.002 \times 1.5 = 0.003\ \mu g/g$

$EPC_{WES} = 2\ \mu g/\ell$, as Ni
$EPC_{LE} = 0.002 \times 2 = 0.004\ \mu g/g$, as Ni

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
Category	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m^3 (ppm Vol)			4.3E1		0.1		
Water, μg/l (ppm Wt)			6.5E2	1.0E1†	1.5	2 †	
Land, μg/g (ppm Wt)			1.3E0	2E-2 †	0.003	0.004†	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m^3 (ppm Vol)			0.8 (0.0001)		0.1
Water, μg/l (ppm Wt)		2 †	5		1.5
Land, μg/g (ppm Wt)			0.01	0.004 †	0.003

† As Ni

CATEGORY: 78

WLN: CU

COPPER AND COPPER COMPOUNDS (AS COPPER), Cu (cuprum):

An orange, ductile, malleable metal.

STRUCTURE:

Cu Cu^{+} Cu^{+2}

PROPERTIES: Atomic number: 29; group lb; atomic wt: 63.546; mp: 1,083 ± 0.1; bp: 2336; d: 8.92; insoluble; vap. press: 1 mm at 1628°C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Copper forms two series of compounds, cuprous (Cu^{+1}) and cupric (Cu^{+2}). Cupric compounds are the more stable. They ionize in aqueous solution.

Rural background concentration in air is reported as 0.01 to 0.41 $\mu g/m^3$ (ref. 1). Another source reports concentrations ranging from 0.06 to 0.078 as a constituent of suspended particulates in non-urban air (ref. 3). Copper salts are in the form of dusts and mists: metallic copper may occur as fume (ref. 4).

Concentration in freshwater as indicated from hydrologic benchmark samples ranges from zero to 40 $\mu g/\ell$; out of 126 samples 87 were zero (ref. 64). Another report indicates that the average fresh-water copper concentration in U. S. surface water is 13.8 $\mu g/\ell$ with a range of 0.8-280 $\mu g/\ell$ (ref. 28). Natural concentration in seawater is reported as 0.001 mg/ℓ (ref. 28) to 0.02 mg/ℓ (ref. 24). Copper imparts a taste to water in concentrations as low as 1 mg/ℓ (ref. 33). Occurrence in earth's crust is 70 ppm (ref. 24). Copper is found in soils at about 20 $\mu g/g$ (ref. 128).

Copper is an essential element in plants and animals; adult intake of copper is from 2 to 2.5 mg daily (ref. 4).

TOXIC PROPERTIES, HEALTH EFFECTS:

Copper in the form of salts may cause irritation to the gastrointestinal tract if ingested; chronic exposure may result in anemia. Exposure to metallic copper fume may cause respiratory irritation, and eye and skin irritations. Damage to the liver, kidneys, and nervous system may result from exposure to copper (ref. 4,9).

LD_{50} (intraperitoneal, mouse): 3500 $\mu g/\ell$.

LD_{50} (oral, rat): 140 mg/kg for $CuCl_2$; this is equivalent to 66 mg/kg as Cu^{+2}.

Aquatic toxicity: Copper has a synergistic action with zinc, cadmium, and mercury. Concentration of calcium and magnesium influence the toxicity of copper.

The 96 hr LC_{50} for Piephales promelas (fathead minnow) is 0.05 ppm for $CuSO_4$ in soft water, 1.4 ppm in hard water (ref. 28). Copper inhibits photosynthesis of giant kelp, at 0.06 mg/ℓ and it is toxic to oysters at 0.1 mg/ℓ (ref. 28). It has a concentration factor of 30,000 in marine phytoplankton, and 1,000 in marine fish (ref. 28).

Phytotoxicity: Copper concentrations of 0.1 to 1.0 mg/ℓ in nutrient solutions are toxic to a number of plants (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (metallic copper fume): 0.2 mg/m^3.

TLV (dusts and mists): 1 mg/m^3.

Copper is included on EPA Consent Decree Priority III List.

U.S. Public Health Service Drinking Water Regulations, 1962, Levels for Alternate Source Selection: 1.0 mg/ℓ (ref. 66).

EPA 1976 Water Quality Criteria (proposed): for domestic water supplies (welfare): 1.0 mg/ℓ; for freshwater and marine aquatic life: application factor--0.1 (to be applied to 96-hour LC_{50}, nonaerated bioassay)(ref. 33).

NAS/NAE 1972 Water Quality Criteria: for public water supply sources: 1 mg/ℓ; for freshwater aquatic life: application factor--0.1 (to be applied to 96-hour LC_{50}); for marine aquatic life: hazard level--0.05 mg/ℓ; minimal risk of deleterious effects--0.01 mg/ℓ; application factor--0.01 (to be applied to 96-hour LC_{50}); for livestock: 0.5 mg/ℓ; for irrigation: 0.20 mg/ℓ for continuous use on all soils (ref. 28).

Recommendation of U. S. Department of Agriculture and Land Grant Institutions: Copper concentration for most soils--250 kg/hectare (ref. 112).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 200 $\mu g/m^3$

Water, Health: 5 x 1000 = 5,000 $\mu g/\ell$

Land, Health: 0.002 x 5,000 = 10 $\mu g/g$

Air, Ecology:

Water, Health: 5 x 10 = 50 $\mu g/\ell$

Land, Ecology: 0.002 x 50 = 0.1 $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.2/420 = 0.5\ \mu g/m^3$

$EPC_{WH1} = 15 \times 0.5 = 7.5\ \mu g/\ell$

$EPC_{WH2} = 13.8 \times 0.2 = 3\ \mu g/\ell$

$EPC_{WHS} = 1,000\ \mu g/\ell$

$EPC_{LH} = 0.002 \times 1000 = 2\ \mu g/g$

$EPC_{WES} = 10\ \mu g/\ell$

$EPC_{LE} = 0.002 \times 10 = 0.2\ \mu g/g$

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			2.0E2		0.5		0.01 to 0.41
Water, $\mu g/l$ (ppm Wt)			5.0E3	5.0E1	1,000	10	13.8 1 to 20†
Land, $\mu g/g$ (ppm Wt)			1.0E1	1.0E-1	2	0.2	20

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.5		
Water, $\mu g/l$ (ppm Wt)	1,000	10			
Land, $\mu g/g$ (ppm Wt)			2	0.2	

†For seawater.

CATEGORY: 79

WLN: .AG

SILVER AND SILVER COMPOUNDS (AS SILVER), Ag (argentum).
A white, lustrous, and malleable metal; regular crystalline structure.

STRUCTURE:

Ag Ag^{+}

PROPERTIES:

Atomic number 47; an element in the gold family; group lb; atomic wt: 107.868; mp: 960.5; bp: 1950; d: 10.5; valency: +1.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Rural background concentration measured in air is zero $\mu g/m^3$ (ref. 1). Particle densities for silver agglomerates are 10.5 g/cc for normal density and 0.25 g/cc for floc density (ref. 3).

Most silver compounds are insoluble; the nitrate, Ag NO_3 is soluble. Natural concentration in seawater is 0.3 $\mu g/\ell$ (ref. 28). Concentration in freshwater as indicated from hydrologic benchmark samples ranges from zero to 50 $\mu g/\ell$; out of 18 samples, 11 were zero (ref. 64).

Occurrence in the earth's crust is 0.1 ppm (ref. 24).

TOXIC PROPERTIES, HEALTH EFFECTS:

Exposure to minor amounts of silver over long periods result in permanent skin discoloration. Many of the silver salts are irritating to skin and mucous membranes (ref. 24). Skin effects are noted in a human exposed to 1 mg/m^3 (ref. 2). Silver is cumulative in the body; the biological half-life is reported to be about 3 days (ref. 28). Intravenous administration of 700 $\mu g/kg$ as colloidal silver has resulted in human death (ref. 2).

LD_{50} (oral, mouse): 100 mg/kg for colloidal silver.

LD_{50} (oral, mouse): 50 mg/kg for $AgNO_3$ (32 mg/kg, as Ag).

2400 mg/kg silver is reported to produce tumors in rats. The EPA/NIOSH ordering number is 4101. The adjusted ordering number is 1.7.

Aquatic toxicity: Silver is very toxic to aquatic species. Stickleback fish showed toxic effects at 0.005 ppm as Ag (ref. 36). LC_{50} for eggs of the American oyster, Crassostrea virginica: 0.006 mg/ℓ.

Concentrations of 1 $\mu g/\ell$ (silver nitrate) are harmful to various aquatic species (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (metal and soluble compounds, as Ag): 0.01 mg/m^3.

Silver is included on EPA's Consent Decree Priority III List.

National Interim Primary Drinking Water Regulation: 0.05 mg/ℓ (ref. 102).

U.S. Public Health Service Drinking Water Regulations, Levels for Source Rejection: 0.05 mg/ℓ (ref. 66).

EPA 1976 Water Quality Criteria (proposed): For domestic water supply (health): 50 $\mu g/\ell$; for marine and freshwater aquatic life: application factor--0.01 (to be applied to 96-hour LC_{50} (ref. 33).

NAS/NAE Water Quality Criteria, 1972: For marine aquatic life: hazard level--5 $\mu g/\ell$; minimal risk of deleterious effects--1 $\mu g/\ell$; application factor--0.05 (to be applied to 96-hour LC_{50}) (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 10 $\mu g/m^3$
Water, Health: 5 x 50 = 250 $\mu g/\ell$
Land, Health: 0.002 x 250 = 0.5 $\mu g/g$

Air, Ecology:
Water, Ecology: 5 x 1 = 5 $\mu g/\ell$
Land, Ecology: 0.002 x 5 = 0.01 $\mu g/g$

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.01/420 = 0.024$ $\mu g/m$
$EPC_{WH1} = 15 \times 0.024 = 0.4$ $\mu g/\ell$
$EPC_{WH2} = 13.8 \times 0.01 = 0.14$ $\mu g/\ell$
$EPC_{WHS} = 50$ $\mu g/\ell$
$EPC_{LH} = 0.002 \times 50 = 0.1$ $\mu g/g$
$EPC_{AC2} = 10^3/(6 \times 1.7) = 98$ $\mu g/m^3$
$EPC_{WC} = 15 \times 98 = 1{,}470$ $\mu g/\ell$
$EPC_{LC} = 0.002 \times 1{,}470 = 3$ $\mu g/g$

$EPC_{WES} = 5$ $\mu g/\ell$
$EPC_{LE} = 0.002 \times 5 = 0.01$ $\mu g/g$

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			1.0E1		0.024		0
Water, $\mu g/l$ (ppm Wt)			2.5E2	5E0	50	5	0-50, 0.3 †
Land, $\mu g/g$ (ppm Wt)			5E-1	1E-2	0.1	0.01	

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.024		98
Water, $\mu g/l$ (ppm Wt)	50	5			1470
Land, $\mu g/g$ (ppm Wt)			0.1	0.01	3

† For seawater

CATEGORY: 81

ZINC AND ZINC COMPOUNDS (AS ZN)

WLN: ZN

STRUCTURE:

Zn Zn^{+2}

PROPERTIES:

Atomic wt: 65.38; atomic no.: 30; valence: 2; group: 2b; mp: 419.5; bp: 908; d: 7.14; insoluble; vap press.: 1 mm at 487° C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Zinc occurs in the earth's crust at 0.02 percent by weight (ref. 24). It is usually found in nature as the sulfide (ref. 33). Human intake of zinc is about 10-15 mg/day (ref. 96). Rural zinc are reported between 0.013 and 0.2 $\mu g/m^3$ (ref. 1). Zinc plays a vital metabolic role as a trace element in biological systems. In an analysis of U.S. surface waters, the mean zinc concentration was 51.8 μg/ℓ with a range of 1.0-1,183.0 μg/ℓ (ref. 28). The natural concentration of zinc in seawater is 2 μg/ℓ (ref. 28). Zinc is found in soils typically at about 58 μg/g (ref. 128).

TOXIC PROPERTIES, HEALTH EFFECTS:

Inhalation of fumes can cause metal fume fever; symptoms include fever, nausea, vomiting, aching, cough, and weakness (ref. 24).

LD_{50} (intraperitoneal, mouse): 15 mg/kg

Zinc in water produces undesirable aesthetic effects (ref. 33).

Aquatic toxicity: In hardwater (200 mg/ℓ as $CaCO_3$), 0.18 mg/ℓ of zinc reduced fertility of fathead minnow, Pimephales promelas. Rainbow trout eggs did not hatch in soft water with a concentration of 0.04 mg/ℓ of zinc.

96-hour LC_{50} for fathead minnow: 0.87 mg/ℓ zinc in softwater (20 mg/ℓ as $CaCO_3$) (ref. 28).

Phytotoxicity: Zinc concentrations of 0.4-1.6 mg/ℓ in nutrient solutions are toxic to certain varieties of soybeans (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (for zinc oxide fumes): 5 mg/m^3; (for zinc oxide dust, nuisance particulate): 10 mg/m^3; 5 mg/m^3 ZnO is equivalent to 4 mg/m^3 as Zn.

Zinc oxide is the subject of a NIOSH Criteria Document. The NIOSH recommendation for occupational exposure is 5 mg/m^3 as a 10-hour workday, 40-hour workweek time-weighted average. A ceiling concentration of 15 mg/m^3 is also recommended (ref. 135).

Zinc is included on the EPA Consent Decree List, Priority III. It is a candidate for the list for Toxic Pollutant Effluent Standards (ref. 10).

U.S. Public Health Service Drinking Water Regulations, Levels for Alternate Source Selection: 5 mg/ℓ (ref. 66).

EPA 1976 Water Quality Criteria (proposed): For domestic water supplies, (welfare): 5,000 μg/ℓ; for freshwater aquatic life: application factor--0.01 (to be applied to the 96-hour LC_{50}) (ref. 33).

NAS/NAE 1972 Water Quality Criteria: For public water supply: 5 mg/ℓ; for freshwater aquatic life: application factor--0.0005 (to be applied to 96-hour LC_{50}); for marine aquatic life: hazard level--0.1 mg/ℓ; minimal risk of deleterious effects--0.02 mg/ℓ; application factor: 0.01 (to be applied to the 96-hour LC_{50}); application factor 0.001 when other heavy metals (Cu, Cd) are present; for livestock; 25 mg/ℓ; for irrigation: 2.0 mg/ℓ for continuous use on all soils (ref. 28).

Recommendations of the U.S. Department of Agriculture and Land Grant Institutions: Zinc concentrations in most soils: 500 kg/hectare (ref. 112).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 4×10^3 $\mu g/m^3$	Air, Ecology:
Water, Health: $5 \times 5{,}000 = 2.5 \times 10^4$ μg/ℓ	Water, Ecology: $5 \times 20 = 100$ μg/ℓ
Land, Health: $0.002 \times 2.5 \times 10^4 = 50$ μg/g	Land, Ecology: $0.002 \times 100 = 0.2$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 4/420 = 9.5\ \mu g/m^3$	
$EPC_{WH1} = 15 \times 9.5 = 143$ μg/ℓ	$EPC_{WE1} = 50 \times 0.87 = 43.5$ μg/ℓ
$EPC_{WH2} = 13.8 \times 4 = 55$ μg/ℓ	
$EPC_{WHS} = 5{,}000$ μg/ℓ	$EPC_{WES} = 20$ μg/ℓ
$EPC_{LH} = 0.002 \times 5{,}000 = 10$ μg/g	$EPC_{LE} = 0.002 \times 20 = 0.04$ μg/g

	EMISSION LEVEL GOALS						
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			4.0E3		9.5		0.013-0.2
Water, $\mu g/l$ (ppm Wt)			2.5E4	1.0E2	5,000	20	52, 2 †
Land, $\mu g/g$ (ppm Wt)			5.0E1	2E-1	10	0.04	58

*To be multiplied by dilution factor

	AMBIENT LEVEL GOALS				
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			9.5		
Water, $\mu g/l$ (ppm Wt)	5,000	20			
Land, $\mu g/g$ (ppm Wt)			10	0.04	

† For seawater

CATEGORY: 82

WLN: CD

STRUCTURE:

CADMIUM AND CADMIUM COMPOUNDS (AS CADMIUM), Cd:

A white, ductile metal.

PROPERTIES: Atomic number: 48; an element of the zinc family; group 2b; atomic wt: 112.4; mp: 320.9; bp: 765; d: 8.64; insoluble; generally divalent (+2); vap. press: 1 mm at 394°C.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Cadmium emitted to the atmosphere is generally in the form of particulates-as the oxide, sulfide, or sulfate (ref. 136). Rural background concentration in air is 0.0004 to 0.028 μg/m^3 (ref. 1). Most natural waters contain <10 μg/ℓ (ref. 28). Natural concentration of seawater is 0.02 (ref. 28) to ~0.1 μg/ℓ (refs. 28, 69). Soil background levels from 0.2-1.4 kg/hectare (average ≈ 0.1) are indicated (ref. 118). Occurrence in earth-s crust is 0.1-0.2 ppm (ref. 24).

Normal daily intake by humans is estimated as 72 μg/day of Cd (ref. 113).

Pure cadmium metal is not found in nature. It occurs usually with zinc; the weight ratio of cadmium to zinc varies from 0.0002 to 0.002 (ref. 137). Cadmium does not form organic compounds as does mercury or lead.

TOXIC PROPERTIES, HEALTH EFFECTS:

Cadmium is highly toxic (ref. 136). Inhalation or ingestion of cadmium produces both acute and chronic effects. Inhalation of 0.01-0.27 mg/m^3 resulted in pulmonary and renal effects for exposed workers (ref. 4). Ingestion of 13-15 ppm in popsicles was toxic to children (ref. 96). Maximum normal body burden is 20-30 mg (ref. 93). The biological half life is 16-33 years, estimate (ref. 93). Minimum detectable health effects have been theoretically associated with long-term (25-30 years) exposure to air concentration of 2.5 μg/m^3 (ref. 136).

LD_{50} (oral, rat): 72 mg/kg for CdO. This is equivalent to 63 mg/kg as Cd.

Cadmium and several cadmium compounds are reported to produce oncogenic and teratogenic effects. The International Agency for Research on Cancer has concluded that occupational exposure to cadmium in some form (possibly the oxide) increase the risk of cancer in man (ref. 133). The EPA/NIOSH ordering number based on oncogenic potential for cadmium and its compounds collectively is 7329. The lowest dose reported to produce an oncogenic response in an animal is 1 mg/kg, as Cd. The adjusted ordering number is 7329. The EPA/NIOSH ordering number based on teratogenic effects is 4305. The lowest dose to produce a teratogenic effect is 1 mg/kg, as Cd. The adjusted ordering number is 4305.

Aquatic toxicity: Acute lethal concentration for most freshwater fish varies from 0.01 to 10 mg/ℓ (ref. 69). Reproduction of Daphnia magna at reduced to 0.0005 mg/ℓ (ref. 28). The 7 day LC_{50} for rainbow trout (salmo gairdneri) is 0.008-0.01 ppm (ref. 28).

Cadmium is a dangerous, cumulative poison. A concentration factor up to 1000 has been reported (ref. 28).

Zinc and copper increase toxicity (refs. 28, 69). Oysters may concentrate cadmium from very low levels in ambient water (ref. 28).

Phytotoxicity: There is evidence that cadmium in soil is taken up by certain plants (ref. 136). Yields of beans, turnips, and beets are reduced by 0.10 mg/ℓ in nutrient solutions (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (dust and salts, as Cd; cadmium oxide fume, as Cd): 0.05 mg/m^3. Cadmium oxide production is classified by ACGIH as "Suspect of Carcinogenic Potential for Man."

Cadmium is designated for EPA Toxic Pollutant Effluent Standards because of toxicity to aquatic life (ref. 10). It appears on EPA Consent Decree, Priority 1 list.

National Interim Primary Drinking Water Regulations: 0.010 mg/ℓ (ref. 102).

U.S. Public Health Service Drinking Water Regulations- Levels for Source Rejection: 0.01 mg/ℓ (ref. 66).

EPA Water Quality Criteria 1976 (proposed): For domestic water supply (health): 10 μg/ℓ for freshwater aquatic life: soft water--0.4-4 μg/ℓ; for hard water--1.2-12 μg/ℓ ; for marine: 5 μg/ℓ (ref. 33).

NAS/NAE Water Quality Criteria, 1972: For public water supply sources--0.10 mg/ℓ; for freshwater aquatic life: for hard water (>100 mg/ℓ, as $CaCO_3$): maximum--0.03 mg/ℓ, safe level--0.003 mg/ℓ; for soft water (<100 mg/ℓ, as $CaCO_3$): maximum--0.004 mg/ℓ, safe level--0.0004 mg/ℓ; for marine aquatic life: hazard level--0.01 mg/ℓ; minimal risk of deleterious effects--0.2 μg/ℓ; application factor--0.01 (to be applied to 96-hour LC_{50}), lower in presence of copper and/or zinc; for livestock: 50 μg/ℓ; for irrigation: 0.010 mg/ℓ for continuous use on all soils (ref. 28).

Recommendation of U. S. Department of Agriculture and Land Grant Colleges: Concentration of cadmium (most soils)--10 kg/hectare (ref. 112).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: $7 \times 10^4/7329 = 10$ μg/m^3

Water, Health: $5 \times 10 = 50$ μg/ℓ

Land, Health: $0.002 \times 50 = 0.1$ μg/g

Air, Ecology:

Water, Ecology: $5 \times 0.2 = 1$ μg/ℓ

Land, Ecology: $0.002 \times 1 = 0.002$ μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

$EPC_{AH1} = 10^3 \times 0.05/420 = 0.12$ μg/m^3

$EPC_{WH1} = 15 \times 0.12 = 1.8$ μg/ℓ

$EPC_{WH2} = 13.8 \times 0.05 = 0.7$ μg/ℓ

$EPC_{WHS} = 10$ μg/ℓ

$EPC_{LH} = 0.002 \times 10 = 0.02$ μg/g

$EPC_{AC1} = 10^3 \times 0.05/420 - 0.12$ μg/m^3 (for CdO, as Cd)

$EPC_{AC2} = 10^3 \times (6 \times 7329) = 0.02$ μg/m^3

$EPC_{WC} = 15 \times 0.02 = 0.3$ μg/ℓ

$EPC_{LC} = 0.002 \times 0.3 = 0.0006$ μg/g

$EPC_{WES} = 0.4$ μg/ℓ (freshwater, soft)

$EPC_{WES} = 0.2$ μg/ℓ (marine)

$EPC_{LE} = 0.002 \times 0.2 = 0.0004$ μg/g

$EPC_{AT} = 10^3/(6 \times 4305) = 0.04$ μg/m^3

$EPC_{WT} = 15 \times 0.04 = 0.6$ μg/ℓ

$EPC_{LT} = 0.002 \times 0.6 = 0.0001$ μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, μg/m³ (ppm Vol)			1.0E1		0.02		0.0004 to 0.028
Water, μg/l (ppm Wt)			5.0E1	1.0E0	10	0.4 0.2	<10† 0.02 - 0.1‡
Land, μg/g (ppm Wt)			1.0E-1	2.0E-3	0.0006	0.0004	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, μg/m³ (ppm Vol)			0.12		0.02
Water, μg/l (ppm Wt)	10	0.4† 0.2‡			
Land, μg/g (ppm Wt)			0.02	0.0004	0.0006

†For freshwater.
‡For seawater.

MERCURY AND MERCURY COMPOUNDS (AS MERCURY) except Alkyl:

Mercury, Hg (quick silver).

A silvery, liquid, metallic element.

STRUCTURE:

Hg^{+1} Hg^{+2}

PROPERTIES: Atomic number: 80; group 8a; atomic wt: 200.61; mp: -38.87; bp: 356.6; d: 13.546; vap. press: 1 mm at 126.2°C; valency: +1, +2; insoluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Mercury is associated with particulate matter in the atmosphere. Background concentration in U. S. rivers and streams is reported as <0.5 μg/ℓ (ref. 64) with most less than 0.1 μg/ℓ (ref. 28).

Natural concentration in seawater ranges 0.03 μg/ℓ (ref. 69) to 0.1 μg/ℓ (ref. 28).

Biological methylation may occur in bottom sediments resulting in continuous levels of methyl mercury in the water (ref. 28). A normal range for Hg present in soils is 0.02-0.6 kg/hectare (ref. 118). Occurrence in earth's crust is 0.5 ppm (ref. 24). Human intake of mercury averages 5-10 μg/day (ref. 93).

TOXIC PROPERTIES, HEALTH EFFECTS:

Acute and chronic effects may result from human exposure to mercury. Inhalation of 1.2 to 8.5 mg/m³ has resulted in acute illness (ref. 3); Ingestion of 1429 mg/kg has resulted in human death (ref. 2). Inhalation of 169 μg/m³ for 40 years has caused central nervous system effects (ref. 2). Mercuric salts are more soluble in the digestive tract and hence more toxic than mercurous salts. The biological half life of mercury is 5 weeks (ref. 22). Except for certain occupational exposures, food, particularly fish, is the greatest contributor to the human body burden of mercury (ref. 28).

Certain mercury compounds have demonstrated oncogenic or teratogenic potential (ref. 2, 32). The EPA/NIOSH ordering number based on oncogenic potential (considering the compounds collectively as Hg) is 4202. The lowest dosage producing tumors is 400 mg/kg. The adjusted ordering number is 10.5.

The teratogenic based ordering number is 7202. The lowest dosage resulting in a teratogenic response is 500 μg/kg. The adjusted ordering number based on a teratogenic potential is 14400.

Aquatic toxicity: Concentrations over 3 μg/ℓ (as mercuric sulfate) are toxic to salmon egs, Oncorhynchus nerka and O. gorbuscha (ref. 28). Acute 96-hour LC_{50} for fish: 1 mg/ℓ for inorganic mercury (ref. 28). Biological magnification up to 27,000 times the water concentration has been reported (ref. 33). The mercury is stored in organisms generally as methyl mercury. Fish eating birds and mammals are affected by excessive mercury in water because of their position at the top of the food chain.

Phytotoxicity: Lesions have been produced on roses at 10μ g/m³ (ref. 138).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV = 0.05 mg/m³. (For all forms except alkyl. The TLV does not recognize oncogenic or teratogenic potential).

Inorganic mercury is the subject of a NIOSH Criteria Document. The NIOSH recommendation for occupational exposure, as an 8-hour workday time-weighted average is 0.05 mg/m³ (ref. 139).

EPA National Emissions Standards for Hazardous Air Pollutants have been established limiting mercury emissions to 2300 g/24 hours from mercury ore processing facilities and mercury cell chlor-alkali plants and 3200 g/24 hrs from facilities that process wastewater treatment plant sludges (ref. 16). Mercury is on the list for EPA Toxic Pollutant Effluent Standards (ref. 10). Mercury is on the EPA Consent Decree List, Priority 1.

FDA guidelines for the maximum level of Hg in edible portions of fish flesh is 0.5 μg/ℓ (ref. 28).

National Interim Primary Drinking Water Regulations: 0.002 mg/ℓ (ref. 102).

EPA 1976 Water Quality Criteria (proposed): For domestic water supply (health): 2.0 μg/ℓ; for freshwater aquatic life and wildlife: 0.05 μg/ℓ; for marine aquatic life: 0.10 μg/ℓ (ref. 33).

NAS/NAE 1972 Water Quality Criteria: For public water supply sources: 0.002 mg/ℓ; for freshwater aquatic life: total mercury body burden in aquatic organisms--0.5 μg/g wet weight; average total concentration--0.05 μg/ℓ; maximum at any time or place--0.2 μg/ℓ; for marine aquatic life: hazard level--0.10 μg/ℓ; for livestock: 10 μg/ℓ (to prevent human consumption of animal tissue containing > 0.5 ppm Hg) (ref. 28).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 50 μg/m³	Air, Ecology: 10 μg/m³
Water, Health: 5 x 2 = 10 μg/ℓ	Water, Ecology: 5 x 50 = 250 μg/ℓ
Land, Health: 0.002 x 10 = 0.02 μg/g	Land, Ecology: 0.002 x 250 = 0.5 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH1} = 10^3 x 0.05/420 = 0.12 μg/m³	EPC_{AE} = 0.1 x 10 = 1 μg/m³
EPC_{WH1} = 15 x 0.12 = 1.8 μg/ℓ	EPC_{WES} = 50 μg/ℓ
EPC_{WH2} = 13.8 x 0.05 = 0.7 μg/ℓ	
EPC_{WHS} = 2 μg/ℓ	
EPC_{LH} = 0.002 x 2 = 0.004 μg/g	EPC_{LE} = 0.002 x 50 = 0.1 μg/g
EPC_{AC2} = 10^3/(6 x 10.5) = 16 μg/m³	EPC_{AT} = 10^3/(6 x 14,400) = 0.01 μg/m³
EPC_{WC} = 15 x 16 = 240 μg/ℓ	EPC_{WT} = 15 x 0.01 = 0.15 μg/ℓ
EPC_{LC} = 0.002 x 240 = 0.5 μg/g	EPC_{LT} = 0.002 x 15 = 0.03 μg/g

EMISSION LEVEL GOALS							
	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			5.0E1	1.0E1	0.01	1	
Water, $\mu g/l$ (ppm Wt)			1.0E1	2.5E2	2	50	<0.5 0.03-0.1†
Land, $\mu g/g$ (ppm Wt)			2.0E-2	5.0E-1	0.004	0.1	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS					
	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.1	1	0.01
Water, $\mu g/l$ (ppm Wt)	2	50			
Land, $\mu g/g$ (ppm Wt)			0.004	0.1	0.03

†For seawater.

CATEGORY: 85

URANIUM AND URANIUM COMPOUNDS (AS URANIUM), U:
A hard, heavy, nickel-white, radioactive metal.

WLN: UR

STRUCTURE:
U U^{+4} U^{+6}

PROPERTIES: Atomic no: 92; group 3b; atomic wt: 238.03; mp: 1132.3; bp: 3818; d: 18.95; valency: +3, +4, +5, +6; insoluble.

NATURAL OCCURRENCE, CHARACTERISTICS, ASSOCIATED COMPOUNDS:

Uranium principally forms tetravalent (uranous) or hexavalent (uranic, uranyl, or uranate) compounds. The oxide UO_3 forms uranates with bases and uranyl salts with acids. Uranium minerals may contain phosphates and vanadates of rare earths. Natural uranium consists of the isotopes U^{238} and U^{235} in the ratio of 140:1. U^{235} is the fissionable isotope. Occurrence in the earth's crust is 2×10^{-5} percent (ref. 28). It averages about 3 g/ton of rock (ref. 96). The natural concentration in seawater is 3 μg/ℓ (ref. 28). Uranium does not occur naturally in most waters above a few micrograms per liter (ref. 28).

TOXIC PROPERTIES, HEALTH EFFECTS:

Natural uranium is highly toxic by virtue of its biochemical activity as well as its radioactivity. The most important route of exposure to uranium is inhalation of insoluble particulate. Radiation exposure is considered cumulative.

There is no evidence linking exposure to levels of 0.15 to 0.25 mg/m^3 (both soluble and insoluble U compounds) with injury to kidney or to blood (ref. 4).

LD_{50} (intravenous, rat): 400 mg/kg for uranium chloride, (250 mg/kg as U^{+4}).

The biological half life of uranium in bone and kidney is reported as 300 days (ref. 96).

Aquatic toxicity: 96-hour LC_{50} for fathead minnow, *Pimephales promelas*: 2.8 mg/ℓ (uranyl sulfate in soft water) (ref. 28).

REGULATORY ACTIONS, STANDARDS, CRITERIA, RECOGNITION, CANDIDATE STATUS FOR SPECIFIC REGULATION:

TLV (Natural soluble and insoluble compounds, as U): 0.2 mg/m^3.

Regulations for Protection against Radiation: Maximum concentrations of materials released to unrestricted areas: Soluble compounds in air: 3×10^{-2} μc/ml (9 μg/m^3); insoluble compounds in air: 2×10^{-12} μc/ml (6 μg/m^3); soluble and insoluble compounds in water: 2×10^{-5} μc/ml (60,000 μg/ℓ). One cone of natural uranium is equivalent to 3,000 kg (ref. 140)

NAS/NAE 1972 Water Quality Criteria: For marine aquatic life: hazard level--0.5 mg/ℓ; minimal risk of deleterious effects--0.1 mg/ℓ; application factor--0.01 (to be applied to 96-hr LC_{50}) (ref. 28).

The pharmacology and toxicology of industrially important uranium compounds has been extensively studied (ref. 141).

MINIMUM ACUTE TOXICITY CONCENTRATIONS:

Air, Health: 9 μg/m^3
Water, Health: 60,000 μg/ℓ
Land, Health: 0.002 x 60,000 = 120 μg/g

Air, Ecology:
Water, Ecology: 5 x 100 = 500 μg/ℓ
Land, Ecology: 0.002 x 500 = 1 μg/g

ESTIMATED PERMISSIBLE CONCENTRATIONS:

EPC_{AH1} = 200/420 = 0.5 μg/m^3
EPC_{WH1} = 15 x 0.5 = 7.5 μg/ℓ
EPC_{WH2} = 13.8 x 0.2 = 3 μg/ℓ
EPC_{LH} = 0.002 x 3 = 0.006 μg/g

EPC_{WES} = 100 μg/ℓ
EPC_{LE} = 0.002 x 100 = 0.2 μg/g

EMISSION LEVEL GOALS

	I. Based on Best Technology		II. Based on Ambient Factors				
	A. Existing Standards	B. Developing Technology	A. Minimum Acute Toxicity Effluent		B. Ambient Level Goal*		C. Elimination of Discharge
	NSPS, BPT, BAT	Engineering Estimates (R&D Goals)	Based on Health Effects	Based on Ecological Effects	Based on Health Effects	Based on Ecological Effects	Natural Background*
Air, $\mu g/m^3$ (ppm Vol)			9E0		0.5		
Water, $\mu g/l$ (ppm Wt)			6.0E4	5.0E2	3	100	3 †
Land, $\mu g/g$ (ppm Wt)			1.2E2	1.0E0	0.006	0.2	

*To be multiplied by dilution factor

AMBIENT LEVEL GOALS

	I. Current or Proposed Ambient Standards or Criteria		II. Toxicity Based Estimated Permissible Concentration		III. Zero Threshold Pollutants Estimated Permissible Concentration
	A. Based on Health Effects	B. Based on Ecological Effects	A. Based on Health Effects	B. Based on Ecological Effects	Based on Health Effects
Air, $\mu g/m^3$ (ppm Vol)			0.5		
Water, $\mu g/l$ (ppm Wt)		100	3		
Land, $\mu g/g$ (ppm Wt)			0.006	0.2	

† For seawater

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ADDITIONAL SOURCES OF INFORMATION CONSULTED
IN THE PREPARATION OF THE MULTIMEDIA
ENVIRONMENTAL GOALS CHARTS

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16. ABSTRACT The report gives results of a study of the derivation of Multimedia Environmental Goals (MEG's). MEG's are levels of significant contaminants or degradents (in ambient air, water, or land, or in emissions or effluents conveyed to the ambient media) that are judged to be: appropriate for preventing certain negative effects in the surrounding populations or ecosystems; or representative of the control limits achievable through technology. In the context of deriving MEG's, Volume I: offers perspective on the broad range of contaminants whose control is vital to both industry and the public; further develops and defines indicators designating contaminants which must be given priority consideration for immediate control and for subsequent research; brings existing and emerging data together for use in environmental assessment; and explores some basic methodologies which provide the present MEG's, and which also suggest directions for refined methodologies. MEG's are projected for more than 650 pollutants: of these, 216 receive full attention in Volume II.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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Environmental Engineering	Multimedia Environmental Goals	05E
Assessments	Environmental Assessment	14B

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