3. CHEMICAL AND PHYSICAL INFORMATION

3.1 CHEMICAL IDENTITY

Arsenic appears in Group V of the periodic table. It exists in four oxidation states: -3, 0, +3, and +5. Table 3-1 summarizes information on the chemical identity of elemental arsenic and some common inorganic compounds of arsenic. The corresponding information for several common organic arsenic compounds is presented in Table 3-2.

3.2 PHYSICAL AND CHEMICAL PROPERTIES

Table 3-3 summarizes important physical and chemical properties of elemental arsenic, As(0), and some common inorganic arsenic compounds. As(0) occurs as two allotropic forms, yellow and metallic gray. The metallic gray form is the stable form under ordinary conditions. The corresponding information for several common organic arsenic compounds is presented in Table 3-4.

Table 3-1. Chemical Identity of Arsenic and Selected Inorganic Arsenic Compounds[a]

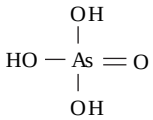
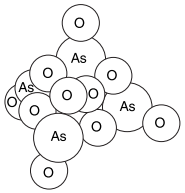
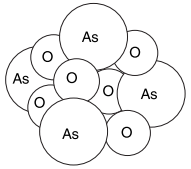
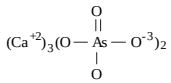
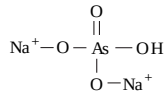
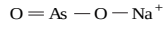
Characteristic	Arsenic	Arsenic acid	Arsenic pentoxide	Arsenic trioxide
Synonym(s)	Arsenic black; colloidal arsenic; gray arsenic	Orthoarsenic acid	Arsenic (V) oxide; arsenic acid anhydride; diarsenic pentoxide	Arsenic oxide; arsenious acid; arsenious oxide; white arsenic
Registered trade name(s)	No data	Dessican L-10®[b]; Scorch®[b]	No data	Arsenolite®[c]; Claudelite®[c]
Chemical formula	As	H_3AsO_4	$As_2O_5(As_4O_{10})$	$As_2O_3(As_4O_8)$
Chemical structure	As			
Identification numbers:				
CAS registry	7440-38-2	7778-39-4	1303-28-2	1327-53-3
NIOSH RTECS	CG0525000	CG070000	CG2275000	CG3325000
EPA hazardous waste	D004	D004, P011	D004, P011	D004, P012
OHM/TADS	No data	No data	No data	No data
DOT/UN/NA/IMCO shipping	UN1558/ IMCO 6.1	UN1553 (liquid) UN1554 (solid) / IMCO 6.1	UN1559/ IMCO 6.1	UN1561/ IMCO 6.1
HSDB	509	431	429	419
NCI	No data	No data	No data	No data

Table 3-1. Chemical Identity of Arsenic and Selected Inorganic Arsenic Compounds[a] (*continued*)

Characteristic	Calcium arsenate	Gallium arsenide	Disodium arsenate	Sodium arsenite
Synonym(s)	Calcium orthoarsenate; arsenic acid, calcium salt	Gallium monoarsenide	Sodium arsenate, dibasic; Disodium hydrogen arsenate; arsenic acid, disodium salt	Arsenious acid, sodium salt; sodium metaarsenite
Registered trade name(s)	Pencal®[b]; Spra-cal®[c]	No data	No data	Atlas A®[b]; Chem Sen®[b]; Kill-All®[b]
Chemical formula	$Ca_3(AsO_4)_2$	GaAs	Na_2HAsO_4	$NaAsO_2$[d]
Chemical structure		Ga:As		
Identification numbers:				
CAS registry	7778-44-1	1303-00-0	7778-43-0	7784-46-5
NIOSH RTECS	CG0830000	LW8800000	CG0875000	CG3675000
EPA hazardous waste	D004	No data	No data	No data
OHM/TADS	No data	No data	No data	7800057
DOT/UN/NA/IMCO shipping	UN1537 / IMCO 6.1	No data	No data	UN1686 (liquid) UN2027 (solid) / IMCO 6.1
HSDB	1433	4376	1675	693
NCI	No data	No data	No data	No data

[a]All information obtained from HSDB 1990, except where noted.
[b]Sittig 1980
[c]IARC 1980
[d]Sax and Lewis 1989
[e]Cotton and Wilkinson 1972

CAS = Chemical Abstracts Service; DOT/UN/NA/IMO = Department of Transportation/United Nations/ North America/International Maritime Dangerous Goods Code; EPA = Environmental Protection Agency; HSDB = Hazardous Substances Data Bank; NCI = National Cancer Institute; NIOSH = National Institute for Occupational Safety and Health; OHM/TADS = Oil and Hazardous Materials/Technical Assistance Data System; RTECS = Registry of Toxic Effects of Chemical Substances

Table 3-2. Chemical Identity of Selected Organic Arsenic Compounds[a]

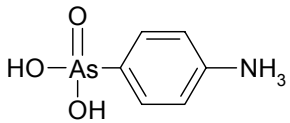
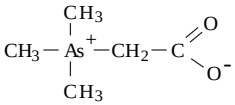
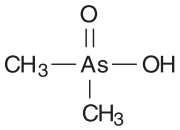
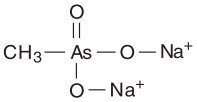
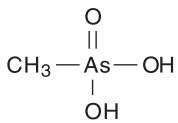
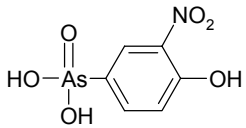
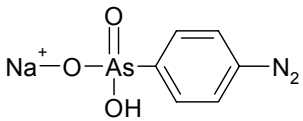
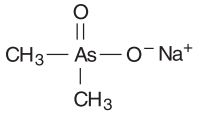
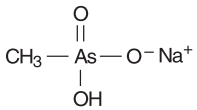
Characteristic	Arsanilic acid	Arsenobetaine	Dimethylarsinic acid	Disodium methanearsonate
Synonym(s)	4-(Aminophenyl)arsonic acid; atoxylic acid[b]	Fish arsenic	Cacodylic acid; hydroxydimethyl-arsine oxide[b]; DMA; DMAA;	DSMA[c]; disodium monomethane arsonate[b]
Registered trade name(s)	Premix®[d] Pro Gen®[d]	No data	Ansar®[c]; Arsan®[c] Silvisar®[c]; Phytar®[c]	Crab-E-Rad®[c]; Metar®[c] Sodar®[c]
Chemical formula	$(C_6H_4NH_2)H_2AsO_3$	$(CH_3)_3As^+CH_2CO_2^-$	$(CH_3)_2As(O)OH$[f]	$CH_3Na_2AsO_3$[b]
Chemical structure				
Identification numbers:				
CAS registry	98-50-0[b]	64436-13-1	75-60-5[b]	144-21-8
NIOSH RTECS	CF7875000	No data	CH7525000	PA2275000
EPA hazardous waste	No data	No data	No data	K084; K101; K102
OHM/TADS	No data	No data	No data	No data
DOT/UN/NA/IMCO shipping	No data	No data	No data	UN1556 (liquid) UN1557 (solid)
HSDB	432	No data	160	1701
NCI	No data	No data	No data	No data

Table 3-2. Chemical Identity of Selected Organic Arsenic Compounds[a] *(continued)*

Characteristic	Methanearsonic acid	3-Nitro-4-hydroxy-phenylarsonic acid	Sodium arsanilate	Sodium dimethylarsinate	Sodium methanearsonate
Synonym(s)	Arsonic acid, methyl-; monomethylarsonic acid[b]	4-Hydroxy-3-nitro-phenylarsonic acid; 3-Nitro-10; roxarsone	Arsanilic acid, sodium salt; sodium amino-arsenate; sodium p-aminophenyl-arsenate[b]	Sodium cacodylate; cacodylic acid, sodium salt; sodium dimethyl arsonate[b]	MSMA[c] ; monosodium methanearsenate[b]
Registered trade name(s)	No data	No data	Arsamin[b]	Sivisar®; Ansar; Pyntar®	Bueno®[c]; Daconate®[c] Phybane®[c]
Chemical formula	$CH_3H_2AsO_3$	$(C_6H_3OHNO_2)H_2AsO_3$	$(C_6H_4NH_2)NaHAsO_3$	$(CH_3)_2NaAsO_2$	$CH_3NaHAsO_3$
Chemical structure					
Identification numbers:					
CAS registry	124-58-3[b]	121-19-7[b]	127-85-5[b]	124-65-2[b]	2163-80-6[e]
NIOSH RTECS	PA1575000	CY5250000	CF9625000	CH7700000	8A2625000
EPA hazardous waste	K031	No data	No data	No data	No data
OHM/TADS	No data	No data	No data	No data	No data
DOT/UN/NA/IMCO shipping	No data	No data	No data	IMCO 6.1 / UN1688	No data
HSDB	845	4296	5189	731	754
NCI	No data	No data	No data	No data	No data

[a]All information obtained from HSDB 1998, except where noted.
[b]Merck 1989
[c]Sittig 1980
[d]IARC 1980
[e]EPA 1982d

CAS = Chemical Abstracts Service; DOT/UN/NA/IMO = Dept. of Transportation/United Nations/ North America/International Maritime Dangerous Goods Code; EPA = Environmental Protection Agency; HSDB = Hazardous Substances Data Bank; NCI = National Cancer Institute; NIOSH = National Institute for Occupational Safety and Health; OHM/TADS = Oil and Hazardous Materials/Technical Assistance Data System; RTECS = Registry of Toxic Effects of Chemical Substances

Table 3-3. Physical and Chemical Properties of Arsenic and Selected Inorganic Arsenic Compounds[a]

Property	Arsenic	Arsenic acid	Arsenic pentoxide	Arsenic trioxide
Molecular weight	74.92	150.95[b]	229.84	197.84
Color	Gray	White	White	White[c]
Physical state	Solid	Solid	Solid	Solid[c]
Melting point	817 EC at 28 atm	35.5 EC	Decomposes at 315 EC	312.3 EC
Boiling point	613 EC sublimes	Loses H_2O at 160 EC	No data	465 EC[c]
Density[g]	5.727 g/cm^3	2.0–2.5 g/cm^3	4.32 g/cm^3	3.738 g/cm^3
Odor	Odorless[e]	No data	No data	Odorless[d]
Odor threshold:				
Water	No data	No data	No data	No data
Air	No data	No data	No data	No data
Solubility:				
Water	Insoluble	3,020 g/L at 12.5 EC	1,500 g/L at 16 EC 767 g/L at 100 EC	37 g/L at 20 EC 115 g/L at 100 EC
Organic solvent(s)	No data	Soluble in alcohol	Soluble in alcohol	Slightly soluble in alcohol[e]
Acids	Soluble in nitric acid	No data	Soluble in acid[d]	Soluble in hydrogen chloride[e]
Partition coefficients:				
Log K_{ow}	No data	No data	No data	No data
Log K_{oc}	No data	No data	No data	No data
Vapor pressure	1 mm Hg at 373 EC[d] 40 mm Hg at 483 EC[d] 100 mm Hg at 518 EC[d]	No data	No data	66.1 mmHg at 312 EC[d]
Henry's law constant at 24.8 EC	No data	No data	No data	No data
Autoignition temperature	No data	No data	No data	Nonflammable[d]
Flashpoint	No data	No data	No data	No data
Flammability limits in air	No data	No data	No data	No data
Conversion factors: ppm (v/v) to mg/m^3 in air at 25 EC mg/m^3 to ppm (v/v) in air at 25 EC	No data	No data	No data	No data
Explosive limits	No data	No data	No data	No data
Valence states	0[e]	+5[e]	+5[e]	+3[e]

Table 3-3. Physical and Chemical Properties of Arsenic and Selected Inorganic Arsenic Compounds[a] *(continued)*

Property	Calcium arsenate	Gallium arsenide	Disodium arsenate	Sodium arsenite
Molecular weight	398.08	144.64	185.91[c]	129.91
Color	Colorless[f]	Dark gray	No data	Gray-white
Physical state	Solid	Solid	Solid[c]	Solid
Melting point	No data	1238 EC	No data	No data
Boiling point	No data	No data	No data	No data
Density[g]	3.62 g/cm^3	5.31[c] g/cm^3	1.87[c,h] g/cm^3	1.87 g/cm^3
Odor	Odorless[d]	No data	Odorless[d]	No data
Odor threshold:				
Water	No data	No data	No data	No data
Air	No data	No data	No data	No data
Solubility:				
Water	0.13 g/L at 25 EC	No data	Soluble in water, glycerol[c,h]	Very soluble
Organic solvents	Insoluble	No data	Slightly soluble in alcohol[c,h]	Slightly soluble in alcohol
Acids	Soluble in dilute acids[d]	No data	No data	No data
Partition coefficients:				
Log K_{ow}	No data	No data	No data	No data
Log K_{oc}	No data	No data	No data	No data
Vapor pressure at 25 EC	No data	No data	No data	No data
Vapor pressure at 30 EC	No data	No data	No data	No data
Henry's law constant at 24.8 EC	No data	No data	No data	No data
Autoignition temperature	No data	No data	No data	No data
Flashpoint	No data	No data	No data	No data
Flammability limits in air	No data	No data	No data	No data
Conversion factors: ppm (v/v) to mg/m^3 in air at 25 EC; mg/m^3 to ppm (v/v) in air at 25 EC	No data	No data	No data	No data
Explosive limits	No data	No data	No data	No data
Valence states	+5[e]	-3	+5	+3

[a]All information obtained from Weast 1985, except where noted.
[b]Value for H_3AsO_4 - ½ H_2O
[c]Merck 1989
[d]HSDB 1990
[e]EPA 1982d
[f]Sax and Lewis 1989
[g]When a property is a function of temperature, the temperature is at room temperature unless otherwise specified.
[h]Heptahydrate

Table 3-4. Physical and Chemical Properties of Selected Organic Arsenic Compounds[a]

Property	Arsenilic acid	Arsenobetaine	Dimethylarsinic acid	Disodium methanearsonate
Molecular weight	217.06[b]	178.06[c]	138.00[d]	183.9[e]
Color	White[c]	No data	Colorless[c]	Colorless[c]
Physical state	Solid	Solid[c]	Solid[f]	Solid[c]
Melting point	232 EC[b]	204–210 EC[c]	195–196 EC[f]	>355 EC[c]
Boiling point	Loses H_2O at 15 EC[c] sublimes	No data	No data	No data
Density	1.9571[c] g/cm^3	No data	No data	No data
Odor	Practically odorless[c]	No data	Odorless[c]	No data
Odor threshold:				
Water	No data	No data	No data	No data
Air	No data	No data	No data	No data
Solubility:				
Water	Very soluble in hot water[b]	No data	660 g/L at 25 EC[g]	1,000 g/L[c]
Organic solvent(s)	Soluble in alcohol; Insoluble in ether[c]	Soluble in alcohol[b]	Very soluble in alcohol[d]	Slightly soluble in alcohol[b]
Acids	Slightly soluble in acetic acid[c]	No data	Very soluble in acetic acid[f]	No data
Partition coefficients:				
Log K_{ow}	No data	No data	No data	No data
Log K_{oc}	No data	No data	No data	No data
Vapor pressure	No data	No data	No data	No data
Henry's law constant at 24.8 EC	No data	No data	No data	No data
Autoignition temperature	No data	No data	No data	No data
Flashpoint	No data	No data	No data	No data
Flammability limits in air	No data	No data	No data	No data
Conversion factors: ppm (v/v) to mg/m^3 in air at 25 EC mg/m^3 to ppm (v/v) in air at 25 EC	No data	No data	No data	No data
Explosive limits	No data	No data	No data	No data
Valence states	+5	+5	+5	+5

Table 3-4. Physical and Chemical Properties of Selected Organic Arsenic Compounds[a] *(continued)*

Property	Methane arsonic acid	3-Nitro-4-hydroxy-phenylarsonic acid	Sodium arsanilate	Sodium dimethylarsinate	Sodium methanearsonate
Molecular weight	139.97[g]	263.03[c]	239.05[b]	159.98[f]	161.96[c]
Color	White	Pale yellow	White[b]	Colorless[c]	No data
Physical state	Solid	Solid[c]	Solid[b]	Solid[f]	No data
Melting point	161 EC[f]	No data	No data	200 EC[c]	115–119 EC[h]
Boiling point	No data	No data	No data	No data	No data
Density	No data	No data	No data	No data	No data
Odor	No data	No data	Odorless[b]	Slight odor[f]	No data
Odor threshold:					
Water	No data	No data	No data	No data	No data
Air	No data	No data	No data	No data	No data
Solubility:					
Water	Soluble[d]	Slightly soluble[c]	Soluble[b]	830 g/L at 22 EC[h]	570 g/L at 25 EC[h]
Organic solvents	Soluble in alcohol[d]	Soluble in alcohol, acetone[c]	Slightly soluble in alcohol[b]	No data	No data
Acids	No data	Soluble in acetic acid[c]	No data	No data	No data
Partition coefficients:					
Log K_{ow}	No data	No data	No data	No data	No data
Log K_{oc}	No data	No data	No data	No data	No data
Vapor pressure at 25 EC	No data	No data	No data	No data	No data
Vapor pressure at 30 EC	No data	No data	No data	No data	No data
Henry's law constant at 24.8 EC	No data	No data	No data	No data	No data
Autoignition temperature	No data	No data	No data	No data	No data
Flashpoint	No data	No data	No data	No data	No data
Flammability limits in air	No data	No data	No data	No data	No data
Conversion factors:	No data	No data	No data	No data	No data
Explosive limits	No data	No data	No data	No data	No data
Valence states	+5	+5	+5	+5	+5

[a]All information obtained from Weast 1985, except where noted.
[b]Sax and Lewis 1989
[c]HSDB 1990
[d]Lide 1996
[e]IARC 1980
[f]Merck 1989
[g]Hood 1985
[h]EPA 1982c