CHAPTER 4. CHEMICAL AND PHYSICAL INFORMATION

4.1 CHEMICAL IDENTITY

Antimony (Sb) is in the fourth row of group 5A (IUPAC group 15) in the periodic table, residing between arsenic and bismuth. Antimony displays four oxidation states: -3, 0, +3, and +5. The most common and stable oxidation states of antimony in aqueous solutions and biological fluids are Sb(III) and Sb(V). Antimony is sometimes referred to as a metalloid, indicating that it displays both metallic and nonmetallic characteristics (Li 2011).

Table 4-1 lists the common synonyms, trade names, and other pertinent identification information for antimony and selected antimony compounds.

Table 4-1. Chemical Identity of Antimony and Compounds[a]

Characteristic	Information		
Chemical name	Antimony	Antimony pentasulfide	Antimony pentoxide
Synonym(s)	Antimony black; stibium, antimony regulus	Antimonial saffron; antimonic sulfide; antimony red; antimony; golden antimony sulfide, antimony persulfide[c]	Antimonic oxide; antimony pentaoxide; diantimony pentoxide; stibic anhydride; antimonic anhydride; antimonic acid[c]
Registered trade name(s)	No data	No data	No data
Chemical formula	Sb[b]	S_5Sb_2[d]	O_5Sb_2[d]
Chemical structure	Sb	No data	No data
CAS Registry Number	7440-36-0	1315-04-4	1314-60-9

Table 4-1. Chemical Identity of Antimony and Compounds[a]

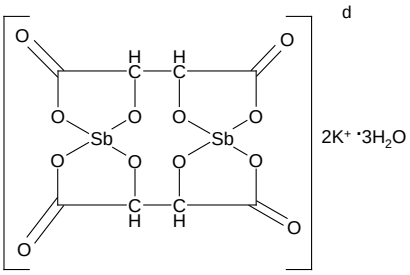
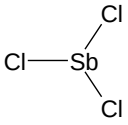
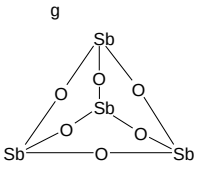
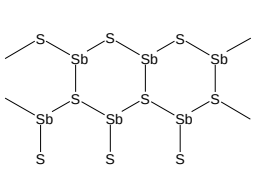
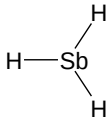
Characteristic	Information	
Chemical name	Ammonium potassium tartrate	Antimony trichloride
Synonym(s)	Antimonial potassium tartrate; potassium antimonial tartrate; tartox; tartrated antimony; potassium antimony tartrate; tartar emetic	Antimonous chloride; antimony butter; antimony(III) chloride; trichlorostibine; chloride antimony
Registered trade name(s)	No data	No data
Chemical formula	$C_8H_4K_2O_{12}Sb_2 \cdot 3H_2O$[d]	Cl_3Sb
Chemical structure		
CAS Registry Number	28300-74-5	10025-91-9

Table 4-1. Chemical Identity of Antimony and Compounds[a]

Characteristic	Information		
Chemical name	Antimony trioxide	Antimony trisulfide	Stibine
Synonym(s)	Antimonious oxide; antimony oxide; diantimony trioxide[d]; flowers of antimony[d]; antimony sesquioxide[e]; senmarmontite; valentinite; antimony white; antimony peroxide; timothox; exitelite	Antimonous sulfide; antimony glance; antimony orange; 130antimony crimson; antimony sesquisulfide; antimony sulfide; antimony vermilion; stibite; antimony needles	Antimony hydride; antimony trihydride; hydrogen antimonide
Registered trade name(s)	Hd[f]; LP[f]; KR[f]; White Star[f]; White Star M[f]; KR-LTS[f]; Thermoguard S[f]; Thermoguard L[f]; H Grade[f]; L Grade[f]; Fire Shield L[f]; Montana Brand[f]	No data	No data
Chemical formula	O_3Sb_2	S_3Sb_2	H_3Sb
Chemical structure	 [g]	 [g]	
CAS Registry Numer	1309-64-4	1345-04-6	7803-52-3

[a]All information obtained from HSDB (2005a, 2005b, 2009a, 2009b, 2013, 2014) except where noted.
[b]Weast 1988.
[c]RTECS 2015.
[d]Windholz 1983.
[e]Freedman et al. 1978.
[f]Avento and Touval 1980.
[g]Cotton and Wilkinson 1966.

CAS = Chemical Abstracts Service

4.2 PHYSICAL AND CHEMICAL PROPERTIES

The physical and chemical properties of antimony and selected antimony compounds are given in Table 4-2. Antimony metal is stable under ordinary conditions. Antimony is a poor conductor of heat and electricity (Li 2011). Antimony forms complex ions with organic and inorganic acids. Stable complexes, such as $Sb_2S_4^{2-}$, may form when antimony is in the presence of sulfur (Bodek et al. 1988).

Stibine (SbH_3) is a gaseous antimony compound in which antimony is in the -3 valence state. Stibine is formed by the action of acids on metal antimonides or antimony alloys by the reduction of antimony compounds, or by the electrolysis of acidic or basic solutions where antimony is present in the cathode. There is a danger of stibine being liberated from overcharged lead storage batteries in which antimony is alloyed into the lead. Stibine slowly decomposes into metallic antimony and hydrogen. It is readily, and sometimes violently, oxidized by air to form antimony trioxide and water (Freedman et al. 1978).

Table 4-2. Physical and Chemical Properties of Antimony and Compounds[a]

Property	Information		
Chemical name	Antimony	Antimony pentasulfide	Antimony pentoxide
Molecular weight	121.75	403.80	323.5 (anhydrous)
Color	Silvery white	Yellow	Yellow
Physical state	Solid	Solid	Solid
Valence state	0	+5	+5
Melting point (°C)	630.5	75 (decomposes)	380 (decomposes)[f]
Boiling point (°C)	1,750; 1,325[b]; 1,635[c]	No data	No data
Density (g/cm^3) at 20°C	6.684 (at 25°C); 6.688[b]	4.12	3.78
Odor	No data	Odorless[c]	No data
Odor threshold:			
Water	No data	No data	No data
Air	No data	No data	No data
Taste	No data	No data	No data
Taste threshold	No data	No data	No data
Solubility:			
Water at 20°C	Insoluble	Insoluble	Very slightly soluble
Organic solvents	No data	Insoluble	No data
Partition coefficients:			
Log K_{ow}	No data	No data	No data
Log K_{oc}	No data	No data	No data
Vapor pressure (mmHg) at 20°C	1 (at 886°C)[d]	No data	No data
Henry's law constant at 25°C	No data	No data	No data
Autoignition temperature	No data	No data	No data
Flashpoint	No data	No data	No data
Flammability limits	No data	No data	No data
Conversion factors (ppm to mg/m^3)	None[e]	None[e]	None[e]
Explosive limits	No data	No data	No data

Table 4-2. Physical and Chemical Properties of Antimony and Compounds[a]

Property	Information	
Chemical name	Antimony potassium tartrate	Antimony trichloride
Molecular weight	333.93	228.11
Color	Colorless	Colorless
Physical state	Solid	Solid
Valence state	+3	+3
Melting point (°C)	100 (-½ mole H_2O)	73.4
Boiling point (°C)	No data	283, 222.6[g]
Density (g/cm^3) at 20°C	2.6	3.140 (at 25°C)
Odor	Odorless[g]	Sharp, unpleasant
Odor threshold:		
Water	No data	No data
Air	No data	No data
Taste	Sweetish, metallic[c]	No data
Taste threshold	No data	No data
Solubility		
Water at 20°C	83 g/L (cold)	6,016 g/L (at 0°C)
Organic solvents	Insoluble in alcohol; soluble in glycerine	Soluble in ABS alcohol, tartaric acid, methylene chloride, benzene, acetone
Partition coefficients		
Log K_{ow}	No data	No data
Log K_{oc}	No data	No data
Vapor pressure (mmHg) at 20°C	No data	1 (at 49.2°C, sublimes)
Henry's law constant at 25°C	No data	No data
Autoignition temperature	No data	No data
Flashpoint	No data	No data
Flammability limits	No data	No data
Conversion factors (ppm to mg/m^3)	None[e]	None[e]
Explosive limits	No data	No data

Table 4-2. Physical and Chemical Properties of Antimony and Compounds[a]

Property	Information		
Chemical name	Antimony trioxide	Antimony trisulfide	Stibine
Molecular weight	291.50	339.69	124.77
Color	White (senarmontite); colorless (valentinite)	Black (stibinite); yellow-red (amorphous)	Colorless[g]
Physical state	Solid	Solid	Gas
Valence state	+3	+3	-3
Melting point (°C)	656	550	-88
Boiling point (°C)	1,550 (sublimes); 1,425[g]	1,150	-17[g]
Density (g/cm^3) at 20°C	5.2 (senarmontite); 5.67 (valentinite)	4.64 (stibinite); 4.12 (amorphous solid)	2.204 (at -17°C)
Odor	Odorless	No data	Disagreeable, like hydrogen sulfide[g]
Odor threshold:			
Water	No data	No data	No data
Air	No data	No data	No data
Taste	No data	No data	No data
Taste threshold	No data	No data	No data
Solubility			
Water at 20°C	Very slightly soluble	1.75 mg/L (at 18°C)	4.1 g/L (at 0°C)
Organic solvents	Soluble in tartaric acid, acetic acid, hydrochloric acid	Soluble in alcohol; insoluble in acetic acid	Soluble in carbon disulfide, ethanol[g]
Partition coefficients			
Log K_{ow}	No data	No data	No data
Log K_{oc}	No data	No data	No data
Vapor pressure (mmHg) at 20°C	1 (at 574°C)[d]	No data	No data
Henry's law constant at 25°C	No data	No data	No data
Autoignition temperature	No data	No data	No data
Flashpoint	No data	No data	No data
Flammability limits	No data	No data	No data
Conversion factors (ppm to mg/m^3)	None[e]	None[e]	1 ppm stibine = 5.1 mg/m^3
Explosive limits	No data	No data	No data

[a]All information obtained from Weast (1988) except where noted.
[b]Herbst et al. 1985.
[c]Windholz 1983.
[d]HSDB 2013.
[e]Since these substances exist in the atmosphere in the particulate state, the concentration is expressed as mg/m^3.
[f]Lewis 2012.
[g]Freedman et al. 1978.