

4. CHEMICAL AND PHYSICAL INFORMATION

4.1 CHEMICAL IDENTITY

Information regarding the chemical identity of the most widely used perchlorates is located in Table 4-1.

4.2 PHYSICAL AND CHEMICAL PROPERTIES

Perchlorates are high melting point inorganic salts that are soluble in water at environmentally significant concentrations. There are five perchlorate salts that are manufactured in substantial amounts: magnesium, potassium, ammonium, sodium, and lithium perchlorate. Perchlorates are powerful oxidizing agents and at elevated temperatures, they can react explosively (Schilt 1979). The production volume of ammonium perchlorate far outpaces the other salts (Mendiratta et al. 1996).

Information regarding the physical and chemical properties of these five perchlorate salts is located in Table 4-2.

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Table 4-1. Chemical Identity of Perchlorates^a

Characteristic	Magnesium perchlorate	Potassium perchlorate	Ammonium perchlorate	Sodium perchlorate	Lithium perchlorate
Synonym(s)	Anhydrous magnesium perchlorate, Perchloric acid, magnesium salt (1:1)	Potassium hyperchloride Perchloric acid, potassium salt (1:1)	Perchloric acid, ammonium salt (1:1) PKHA, APC ^b	Perchloric acid, sodium salt (1:1)	No data
Registered trade name(s)	Anhydrone, Dehydrite	Peroidin, Astrumal, Irenal, Irenat	No data	Irenat	No data
Chemical formula	Mg(ClO ₄) ₂	KClO ₄	NH ₄ ClO ₄	NaClO ₄	LiClO ₄ ^c
Chemical structure	[Mg ²⁺][ClO ₄] ₂	[K ⁺][ClO ₄]	[NH ₄ ⁺][ClO ₄]	[Na ⁺][ClO ₄]	[Li ⁺][ClO ₄]
Identification numbers:					
CAS Registry	10034-81-8	7778-74-7	7790-98-9	7601-89-0	7791-03-9 ^c
NIOSH RTECS	SC8925000	SC9700000	SC7520000	SC9800000	No data
EPA Hazardous Waste ^d	D003	D003	D003	D003	D003
OHM/TADS	No data	No data	7216589	No data	No data
DOT/UN/NA/IMCO	UN1475, IMO 5.1	UN 1489, IMO 5.1	UN1442, IMO 5.1	UN1502, IMO 5.1	UN1481, IMO 5.1 ^e
HSDB	661	1222	474	5038	No data
NCI	No data	No data	No data	No data	0106672 ^f

^aAll information was obtained from HSDB 2002 unless otherwise noted. Perchlorate ion was not included in this table since it is never found independent of a corresponding cation.

^bAshford 1994

^cBudavari et al. 1996

^dEPA 1992a

^eDOT 1998

^fNIH 1999

CAS = Chemical Abstracts Services; DOT/UN/NA/IMCO = Department of Transportation/United Nations/North America/International Maritime Dangerous Goods Code; EPA = Environmental Protection Agency; HSDB = Hazardous Substance 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

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Table 4-2. Physical and Chemical Properties of Perchlorates^a

Property	Magnesium perchlorate	Potassium perchlorate	Ammonium perchlorate	Sodium perchlorate	Lithium perchlorate
Molecular weight	223.21	138.55	117.49	122.44	106.39
Color	White	Colorless or white	White crystals	White	Colorless crystals ^b
Physical state	Solid granular or flaky powder	Solid crystals	Solid orthombic crystals ^c	Solid deliquesce crystals	Solid deliquesce crystals
Melting point	~250 °C dec.	400 °C dec. ^c	130 °C dec. ^d	471 °C dec. ^d	236 °C ^e
Boiling point	N/A	N/A	N/A	N/A	~400 °C dec. ^b
Density at -20 °C	2.21 g/mL ^f	2.52 g/mL	1.95 g/mL	2.02 g/mL ^g	2.43 g/mL
Odor ^b	No odor	No odor	No odor	No odor	No odor
Odor threshold:					
Water	N/A	N/A	N/A	N/A	N/A
Air	N/A	N/A	N/A	N/A	N/A
Taste	No data	No data	Imparts a bitter and salty taste to water ^b	No data	No data
Solubility:					
Freshwater at 25 °C ^f	9.96x10 ⁵ mg/L	2.06x10 ⁴ mg/L	2.49x10 ⁵ mg/L	2.10x10 ⁶ mg/L	5.97x10 ⁵ mg/L
Saltwater at 25 °C	No data	No data	No data	No data	No data
Organic solvent(s) ^d					
Methanol	5.18x10 ⁵ mg/L	1.05x10 ³ mg/L	6.86x10 ⁴ mg/L	5.14x10 ⁵ mg/L	1.82x10 ⁶ mg/L
Ethanol	2.40x10 ⁵ mg/L	1.20x10 ² mg/L	1.91x10 ⁴ mg/L	1.47x10 ⁵ mg/L	1.52x10 ⁶ mg/L
n-Propanol	7.34x10 ⁵ mg/L	1.00x10 ² mg/L	3.87x10 ³ mg/L	4.89x10 ⁴ mg/L	1.05x10 ⁶ mg/L
Acetone	4.29x10 ⁵ mg/L	1.55x10 ³ mg/L	2.26x10 ⁴ mg/L	5.17x10 ⁵ mg/L	1.37x10 ⁶ mg/L
Ethyl acetate	7.09x10 ⁵ mg/L	1.00x10 ¹ mg/L	3.20x10 ² mg/L	9.65x10 ⁴ mg/L	9.51x10 ⁵ mg/L
Ethyl ether	2.91x10 ³ mg/L	No data	No data	No data	1.14x10 ⁶ mg/L
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 °C ^a	Very low	Very low	Very low	Very low	Very low
Polymerization	N/A	N/A	N/A	N/A	N/A
Photolysis	No data	No data	No data	No data	No data

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Table 4-2. Physical and Chemical Properties of Perchlorates^a

Property	Magnesium perchlorate	Potassium perchlorate	Ammonium perchlorate	Sodium perchlorate	Lithium perchlorate
Henry's law constant at 25 °C	No data	No data	No data	No data	No data
Autoignition temperature	N/A	N/A	N/A	N/A	N/A
Flashpoint	N/A	N/A	N/A	N/A	N/A
Flammability limits at 25 °C	N/A	N/A	N/A	N/A	N/A
Incompatibilities	Oil, grease, benzene, calcium hydride, charcoal, fluorolefins, ethanol, strontium hydride, sulfur, sulfuric acid, and carbonaceous material ^{c,f}	Aluminum-magnesium, charcoal, fluorine, magnesium, nickel-titanium, reducing agents, sulfur, oil, grease, benzene, calcium hydride, olefins, ethanol, strontium hydride, sulfuric acid, carbonaceous material ^{c,f}	Nitril perchlorate, potassium iodate, potassium permanganate, crystallized impurities, metals, powdered carbon, ferrocene, sulfur, organic matter, sugar, charcoal, hot copper pipes ^{c,f}	Organic material, oil, grease, benzene, calcium hydride, charcoal, olefins, ethanol, strontium hydride, sulfur, sulfuric acid, carbonaceous material ^{c,f,g}	Sulfur, sulfuric acid, powdered magnesium, aluminum, benzene, calcium hydride, charcoal, olefins, ethanol, strontium hydride, carbonaceous material ^{c,f}
Conversion factors (25 °C)	No data	No data	No data	No data	No data
Explosive limits	N/A	N/A	N/A	N/A	N/A
Other	Sensitive to rubbing, shock, percussion, sparks, and heating. ^b Dissolves in water with evolution of a considerable amount of heat.	Sensitive to rubbing, shock, percussion, sparks, and heating. ^b Can react violently with combustibles. ^c	Sensitive to rubbing, shock, percussion, sparks, and heating. ^b Decomposes explosively on heating to 345–350 °C.	Sensitive to rubbing, shock, percussion, sparks, and heating. ^b Hygroscopic. ^d	Sensitive to rubbing, shock, percussion, sparks, and heating. ^b Hygroscopic.

^aPerchlorate ion was not included in this table since it is never found independent of a corresponding cation. All information was taken from Budavari 1996 unless otherwise noted.

^bVon Burg 1995

^cSax 1984

^dSchilt 1979

^eBauer 1990

^fVogt 1986

^gLewis 1993

dec. = decomposes; N/A = not applicable