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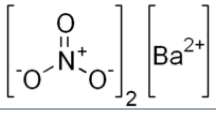
Barium nitrate

Barium nitrate with chemical formula $Ba(NO_3)_2$ is a salt composed of barium and the nitrate ion.

Barium nitrate exists as a white solid at room temperature. It is soluble in water, and like other soluble barium compounds, is toxic. It occurs naturally as the very rare mineral *nitrobarite*.[3] Barium nitrate's properties make it suitable for use in various military applications, including thermite grenades and incendiary ammunition.

Barium nitrate



Names	
Other names Barium dinitrate, , barium salt	
Identifiers	
CAS Number	10022-31-8 (http://www.commonchemistry.org/ChemicalDetail.aspx?ref=10022-31-8) ✓
3D model (JSmol)	Interactive image (http://chemapps.stolaf.edu/jmol/jmol.php?model=%5BBa%2B2%5D.%5BO-%5D%5BN%2B%5D%28%5BO-%5D%29%3DO.%5BO-%5D%5BN%2B%5D%28%5BO-%5D%29%3DO)
ChemSpider	23184 (http://www.chemspider.com/Chemical-Structure.23184.html) ✓
ECHA InfoCard	100.030.006 (https://echa.europa.eu/substance-information/-/substanceinfo/100.030.006)
PubChem CID	24798 (https://pubchem.ncbi.nlm.nih.gov/compound/24798)
RTECS number	CQ9625000
UNII	MDC5SW56XC (https://fdasis.nlm.nih.gov/srs/srsdirect.jsp?regno=MDC5SW56XC) ✗
InChI	
InChI=1S/Ba.2NO3/c;2*2-1(3)4/q+2;2*-1 ✓ Key: IWOUKMZUPDVPGQ-UHFFFAOYSA-N ✓	
InChI=1/Ba.2NO2/c;2*2-1(3)4/q+2;2*-1 Key: IWOUKMZUPDVPGQ-UHFFFAOYAA	
SMILES	
[Ba+2].[O-][N+]([O-])=O.[O-][N+]([O-])=O	
Properties	
Chemical formula	$Ba(NO_3)_2$
Molar mass	261.337 g/mol
Appearance	white, lustrous crystals
Odor	odorless
Density	3.24 g/cm^3
Melting point	592 °C (1,098 °F; 865 K) (decomposes)
Solubility in water	4.95 g/100 mL (0 °C) 10.5 g/100 mL (25 °C) 34.4 g/100 mL (100 °C)
Solubility	insoluble in alcohol
Magnetic susceptibility (χ)	$-66.5 \cdot 10^{-6}$ cm^3/mol
Refractive index (n_D)	1.5659
Structure	
Crystal structure	cubic
Hazards	
Safety data sheet	*See: data page*
EU classification (DSD) *(outdated)*	Harmful (**Xn**)

Contents

Manufacture

Barium nitrate is manufactured by one of two processes. The first involves dissolving small chunks of barium carbonate in nitric acid, allowing any iron impurities to precipitate, then filtered, evaporated, and crystallized. The second requires combining barium chloride with a heated solution of sodium nitrate, causing barium nitrate crystals to separate from the mixture.

Reactions

At elevated temperatures, barium nitrate decomposes to barium oxide, nitrogen dioxide, and oxygen:

$$2Ba(NO_3)_2 + \text{heat} \rightarrow 2BaO + 4NO_2 + O_2$$

In an atmosphere of nitric oxide, thermal decomposition produces barium nitrite ($Ba(NO_2)_2$). Reactions with soluble metal sulfates or sulfuric acid yield barium sulfate. Many insoluble barium salts, such as the carbonate, oxalate and phosphate of the metal, are precipitated by similar double decomposition reactions. Barium nitrate is an oxidizer and reacts vigorously with common reducing agents. The solid powder, when mixed with many other metals such as aluminium or zinc in their finely divided form, or combined with alloys such as aluminium-magnesium, ignites and explodes on impact.[4]

Applications

Baratol is an explosive composed of barium nitrate, TNT and binder; the high density of barium nitrate results in baratol being quite dense as well. Barium nitrate mixed with aluminium powder, a formula for flash powder, is highly explosive. It is mixed with thermite to form Thermate-TH3, used in military thermite grenades. Barium nitrate was also a primary ingredient in the "SR 365" incendiary charge used by the British in the *De Wilde* incendiary ammunition with which they armed their interceptor fighters, such as the Hawker Hurricane and Supermarine Spitfire, during the Battle of Britain.[5] It is also used in the manufacturing process of barium oxide, the vacuum tube industry and for green fire in pyrotechnics.

Health risks

Like all soluble barium compounds, barium nitrate is toxic by ingestion or inhalation. Symptoms of poisoning include tightness of muscles (especially in the face and neck), vomiting, diarrhea, abdominal pain, muscular tremors, anxiety, weakness, labored breathing, cardiac irregularity, and convulsions. Death may result from cardiac or respiratory failure, and usually occurs a few hours to a few days following exposure to the compound. Barium nitrate may also cause kidney damage.[6]

Solutions of sulfate salts such as Epsom salts or sodium sulfate may be given as first aid for barium poisoning, as they precipitate the barium as the insoluble (and non-toxic) barium sulfate.

Inhalation may also cause irritation to the respiratory tract.

While skin or eye contact is less harmful than ingestion or inhalation, it can still result in irritation, itching, redness, and pain.

The Occupational Safety and Health Administration and the National Institute for Occupational Safety and Health have set occupational exposure limits at 0.5 mg/m^3 over an eight-hour time-weighted average.[7]

References

1. "NIOSH Pocket Guide to Chemical Hazards #0046" (https://www.cdc.gov/niosh/npg/npgd0046.html). National Institute for Occupational Safety and Health (NIOSH).
2. "Barium (soluble compounds, as Ba)" (http://www.cdc.gov/niosh/idlh/7440393.html). *Immediately Dangerous to Life and Health*. National Institute for Occupational Safety and Health (NIOSH).
3. Mindat, http://www.mindat.org/min-2918.html
4. Pradyot Patnaik. *Handbook of Inorganic Chemicals*. McGraw-Hill, 2002, ISBN 0-07-049439-8

5. Williams, Anthony G; Emmanuel Gustin (2004). "THE BATTLE OF BRITAIN: ARMAMENT OF THE COMPETING FIGHTERS" (https://web.archive.org/web/20130105162948/http://www.quarry.nildram.co.uk/BoB.htm). *Flying Guns: World War 2.* Crowood Press. Archived from the original (http://www.quarry.nildram.co.uk/BoB.htm) on 5 January 2013. Retrieved 23 December 2012. "The B. Mk VI 'De Wilde' incendiary (named after the original Belgian inventor but in fact completely redesigned by Major Dixon), which contained 0.5 grams of SR 365 (a composition including barium nitrate which ignited on impact with the target) was twice as effective as these, scoring one in five."
6. Barium Nitrate (http://hazard.com/msds/mf/baker/baker/files/b0432.htm)
7. CDC - NIOSH Pocket Guide to Chemical Hazards (http://www.cdc.gov/niosh/npg/npgd0046.html)

R-phrases *(outdated)*	R20/22
S-phrases *(outdated)*	(S2), S28
NFPA 704	
Flash point	noncombustible[1]
Lethal dose or concentration (*LD*, *LC*):	
LD_{50} (median dose)	355 mg/kg (oral, rat) 187 mg/kg (rat, oral)[2]
LD_{Lo} (lowest published)	79 mg Ba/kg (rabbit, oral) 421 mg Ba/kg (dog, oral)[2]
US health exposure limits (NIOSH):	
PEL (Permissible)	TWA 0.5 mg/m^3[1]
REL (Recommended)	TWA 0.5 mg/m^3[1]
IDLH (Immediate danger)	50 mg/m^3[1]
	Supplementary data page
Structure and properties	Refractive index (n), Dielectric constant (ε_r), etc.
Thermodynamic data	Phase behaviour solid–liquid–gas
Spectral data	UV, IR, NMR, MS

Except where otherwise noted, data are given for materials in their standard state (at 25 °C [77 °F], 100 kPa).

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Infobox references

Salts and covalent derivatives of the Nitrate ion

HNO_3																He
$LiNO_3$	$Be(NO_3)_2$											$B(NO_3)_4^-$	C	N	O	FNO_3	Ne
$NaNO_3$	$Mg(NO_3)_2$											$Al(NO_3)_3$	Si	P	S	$ClONO_2$	Ar
KNO_3	$Ca(NO_3)_2$	$Sc(NO_3)_3$	$Ti(NO_3)_4$	$VO(NO_3)_3$	$Cr(NO_3)_3$	$Mn(NO_3)_2$	$Fe(NO_3)_3$, $Fe(NO_3)_2$	$Co(NO_3)_2$, $Co(NO_3)_3$	$Ni(NO_3)_2$	$Cu(NO_3)_2$	$Zn(NO_3)_2$	$Ga(NO_3)_3$	Ge	As	Se	Br	Kr
$RbNO_3$	$Sr(NO_3)_2$	Y	$Zr(NO_3)_4$	Nb	Mo	Tc	Ru	Rh	$Pd(NO_3)_2$	$AgNO_3$	$Cd(NO_3)_2$	In	Sn	$Sb(NO_3)_3$	Te	I	$Xe(NO_3)_2$
$CsNO_3$	$Ba(NO_3)_2$		Hf	Ta	W	Re	Os	Ir	Pt	Au	$Hg_2(NO_3)_2$, $Hg(NO_3)_2$	$Tl(NO_3)_3$, $TlNO_3$	$Pb(NO_3)_2$	$Bi(NO_3)_3$ $BiO(NO_3)$	Po	At	Rn
$FrNO_3$	$Ra(NO_3)_2$		Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og
		↓															
		$La(NO_3)_3$	$Ce(NO_3)_3$, $Ce(NO_3)_4$	Pr	Nd	Pm	Sm	Eu	$Gd(NO_3)_3$	Tb	Dy	Ho	Er	Tm	Yb	Lu	
		$Ac(NO_3)_3$	$Th(NO_3)_4$	Pa	$UO_2(NO_3)_2$	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	