Magnesium hydroxide

From Wikipedia, the free encyclopedia
(Redirected from Milk of magnesia)

Magnesium hydroxide is an inorganic compound with the chemical formula of hydrated $Mg(OH)_2$. As a suspension in water, it is often called **milk of magnesia** because of its milk-like appearance. The solid mineral form of magnesium hydroxide is known as brucite.

Magnesium hydroxide is a common component of antacids and laxatives; it interferes with the absorption of folic acid and iron.[3] Magnesium hydroxide has a low solubility in water, with a K_{sp} of 1.5×10^{-11}.

Contents [hide]

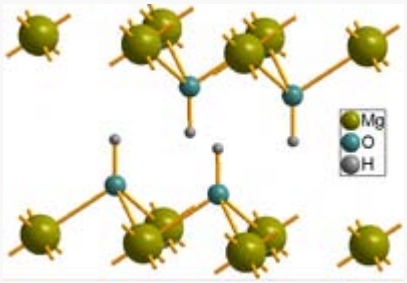
1 History
2 Preparation
3 Uses
4 Biological metabolism
5 Mineralogy
6 References

History [edit]

On May 4, 1818, an American inventor named John Callen, received a patent (No. X2952) for magnesium hydroxide [4]

In 1829, Sir James Murray used a fluid magnesia preparation of his own design to treat[*clarification needed*] the Lord Lieutenant of Ireland, the Marquis of Anglesey, of stomach pain. This was so successful (advertised in Australia and approved by the Royal College of Surgeons in 1838)[5] that he was appointed resident physician to Anglesey and two subsequent Lords Lieutenants, and knighted. His fluid magnesia product was patented two years after his death in 1873.[6]

Magnesium hydroxide



IUPAC name [hide]

Magnesium hydroxide

Other names [hide]

Milk of magnesia

Identifiers	
CAS number	1309-42-8 ✓
PubChem	14791
ChemSpider	14107 ✓
UNII	NBZ3QY004S ✓
EC number	215-170-3
ChEBI	CHEBI:6637 ✓
ChEMBL	CHEMBL1200718 ✗
RTECS number	OM3570000
ATC code	A02AA04, G04BX01
Jmol-3D images	Image 1

SMILES [show]

InChI [show]

Properties	
Molecular formula	$Mg(OH)_2$
Molar mass	58.3197 g/mol
Appearance	White solid
Odor	odorless
Density	2.3446 g/cm^3
Melting point	350 °C (662 °F; 623 K) decomposes
Solubility in water	0.00064 g/100 mL (25 °C)

The term *milk of magnesia* was first used for a white-colored, aqueous, mildly alkaline suspension of magnesium hydroxide formulated at about 8%w/v by Charles Henry Phillips in 1872 [7] and sold under the brand name *Phillips' Milk of Magnesia* for medicinal usage.

Although the name may at some point have been owned by GlaxoSmithKline, USPTO registrations show "Milk of Magnesia" [8] and "Phillips' Milk of Magnesia"[9] both registered to Bayer. In the UK, the non-brand (generic) name of "Milk of Magnesia" and "Phillips' Milk of Magnesia" is "Cream of Magnesia" (Magnesium Hydroxide Mixture, BP).

Preparation [edit]

Magnesium hydroxide can be precipitated by the metathesis reaction between magnesium salts and sodium, potassium, or ammonium hydroxide:

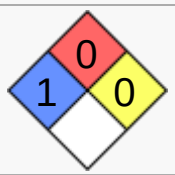
$$Mg^{2+}\ (aq) + 2\ OH^{-}\ (aq) \rightarrow Mg(OH)_2\ (s)$$

Natural magnesium hydroxide exists in the form of brucite, which is used commercially as a fire retardant. However, most industrially used magnesium hydroxide is chemically produced from sea water or brine. Magnesium chloride in the sea water is reacted with lime or dolomitic lime to form a precipitated magnesium hydroxide.[10]

Uses [edit]

Suspensions of magnesium hydroxide in water are used as an antacid to neutralize stomach acid, and as a laxative. The diarrhoea caused by magnesium hydroxide carries away much of the body's supply of potassium, and failure to take extra potassium may lead to muscle cramps.[11] Magnesium hydroxide is also used as an antiperspirant underarm deodorant.[12] Milk of magnesia is useful against canker sores (aphthous ulcer) when used topically.[13]

Milk of magnesia is sold for medical use as chewable tablets, capsules, and as liquids having various added flavors. It is primarily used to alleviate constipation, but also to relieve indigestion and heartburn. When taken orally as a laxative, the osmotic force of the magnesia suspension

	0.004 g/100 mL (100 °C)
Solubility product, K_{sp}	1.5×10^{-11}
Refractive index (n_D)	1.559[1]
Structure	
Crystal structure	hexagonal
Thermochemistry	
Specific heat capacity C	77.03 J/mol K
Std molar entropy $S^{\ominus}_{298}$	64 $J{\cdot}mol^{-1}{\cdot}K^{-1}$[2]
Std enthalpy of formation $\Delta_f H^{\ominus}_{298}$	−924.7 $kJ{\cdot}mol^{-1}$[2]
Gibbs free energy ΔG	-833.7 kJ/mol
Hazards	
MSDS	External MSDS
EU Index	Not listed
NFPA 704	
Flash point	Non-flammable
LD_{50}	8500 mg/kg (rat, oral)
Related compounds	
Other anions	Magnesium oxide
Other cations	Beryllium hydroxide Calcium hydroxide Strontium hydroxide Barium hydroxide
Except where noted otherwise, data are given for materials in their standard state (at 25 °C (77 °F), 100 kPa)	
✗ (verify) (what is: ✓/✗?)	
Infobox references	

acts to draw fluids from the body and to retain those already within the lumen of the intestine, serving to distend the bowel, thus stimulating nerves within the colon wall, inducing peristalsis and resulting in evacuation of colonic contents. It is also used as an antacid, though more modern formulations such as Maalox combine the antimotility effects of equal concentrations of aluminum hydroxide to avoid unwanted laxative effects.

Magnesium hydroxide powder is used industrially as a non-hazardous alkali to neutralize acidic wastewaters.[14] It also takes part in the Biorock method of building artificial reefs.

Solid magnesium hydroxide also has smoke suppressing and fire retarding properties. This is due to the endothermic decomposition it undergoes at 332 °C (630 °F) :

$$Mg(OH)_2\ (s) \rightarrow MgO\ (s) + H_2O\ (g)$$

The heat absorbed by the reaction acts as a retardant by delaying ignition of the associated substance. The water released dilutes any combustible gases and inhibits oxygen from aiding the combustion. Common uses of magnesium hydroxide as a fire retardant include plastics, roofing, and coatings. Other mineral mixtures that are used in similar fire retardant applications are natural mixtures of huntite and hydromagnesite.[15][16][17][18][19]

Biological metabolism [edit]

When the patient drinks the milk of magnesia, the suspension enters the stomach. Depending on how much was taken, one of two possible outcomes will occur.

As an antacid, milk of magnesia is dosed at approximately 0.5–1.5g in adults and works by simple neutralization, where the hydroxide ions from the $Mg(OH)_2$ combine with acidic H^+ ions produced in the form of hydrochloric acid by parietal cells in the stomach to produce water.

As a laxative, milk of magnesia is dosed at 2–5 g, and works in a number of ways. First, Mg^{2+} is poorly absorbed from the intestinal tract, so it draws water from the surrounding tissue by osmosis. Not only does this increase in water content soften the feces, it also increases the volume of feces in the intestine (intraluminal volume) which naturally stimulates intestinal motility. Furthermore, Mg^{2+} ions cause the release of cholecystokinin (CCK), which results in intraluminal accumulation of water, electrolytes, and increased intestinal motility. Although it has been stated in some sources, the hydroxide ions themselves do not play a significant role in the laxative effects of milk of magnesia, as basic solutions (i.e., solutions of hydroxide ions) are not strongly laxative, and non-basic Mg^{2+} solutions, like $MgSO_4$, are equally strong laxatives mole for mole.[20]

Only a small amount of the magnesium from milk of magnesia is usually absorbed from a person's intestine (unless the person is deficient in magnesium). However, magnesium is mainly excreted by the kidneys so long-term, daily consumption of milk of magnesia by someone suffering from renal failure could lead in theory to hypermagnesemia.

Mineralogy [edit]

Brucite, the mineral form of $Mg(OH)_2$ commonly found in nature also occurs in the 1:2:1 clay minerals amongst others, in chlorite, in which it occupies the interlayer position normally filled by monovalent and divalent cations such as Na^+, K^+, Mg^{2+} and Ca^{2+}. As a consequence, chlorite interlayers are cemented by brucite and cannot swell nor shrink anymore.

Brucite, in which some of the Mg^{2+} cations have been substituted by Al^{3+} cations, becomes positively charged and constitutes the main basis of layered double hydroxide (LDH). LDH minerals as hydrotalcite are powerful anion sorbents but are relatively rare in nature.

Brucite may also crystallise in cement and concrete in contact with seawater. Indeed, the Mg^{2+} cation is the second most abundant cation in seawater, just behind Na^+ and before Ca^{2+}. Because brucite is a swelling mineral, it causes a local volumetric expansion responsible for tensile stress in concrete. This leads to the formation of cracks and fissures in concrete, accelerating its degradation in seawater.

For the same reason, dolostone cannot be used as construction aggregate for making concrete. The reaction of magnesium carbonate with the free alkali hydroxides present in the cement porewater also leads to the formation of expansive brucite.

$$MgCO_3 + 2\ NaOH \rightarrow Mg(OH)_2 + Na_2CO_3$$

This reaction, one of the two main alkali-aggregate reaction (AAR) is also known as alkali-carbonate reaction.

References [edit]

1. ^ Pradyot Patnaik. *Handbook of Inorganic Chemicals*. McGraw-Hill, 2002, ISBN 0-07-049439-8
2. ^ *a b* Zumdahl, Steven S. (2009). *Chemical Principles 6th Ed*. Houghton Mifflin Company. p. A22. ISBN 0-618-94690-X.
3. ^ "Magnesium Hydroxide". University of Michigan. 09-01-2007. Check date values in: `|date=` (help)
4. ^ [1]
5. ^ Sir James Murray's condensed solution of fluid magnesia, The Sydney Morning Herald – October 7, 1846
6. ^ Ulster History. Sir James Murray – Inventor of Milk of Magnesia. 1788 to 1871, 24 February 2005
7. ^ http://www.phillipsrelief.com/phillips-frequently-asked-questions/#quest19
8. ^ results from the TARR web server: Milk of Magnesia
9. ^ results from the TARR web server: Phillips' Milk of Magnesia
10. ^ Rothon, RN (2003). *Particulate Filled Polymer Composites*. Shrewsbury, UK: Rapra Technology. pp. 53–100.
11. ^ Magnesium Hydroxide – Revolution Health
12. ^ Milk of Magnesia Makes Good Antiperspirant
13. ^ Canker sores, 2/1/2009
14. ^ Aileen Gibson and Michael Maniocha White Paper: The Use Of Magnesium Hydroxide Slurry For Biological Treatment Of Municipal And Industrial Wastewater, August 12, 2004
15. ^ Hollingbery, LA; Hull TR (2010). "The Thermal Decomposition of Huntite and Hydromagnesite - A

Review". *Thermochimica Acta* **509** (1-2): 1–11. doi:10.1016/j.tca.2010.06.012.

16. ^ Hollingbery, LA; Hull TR (2010). "The Fire Retardant Behaviour of Huntite and Hydromagnesite - A Review". *Polymer Degradation and Stability* **95** (12): 2213–2225. doi:10.1016/j.polymdegradstab.2010.08.019.
17. ^ Hollingbery, LA; Hull TR (2012). "The Fire Retardant Effects of Huntite in Natural Mixtures with Hydromagnesite". *Polymer Degradation and Stability* **97** (4): 504–512. doi:10.1016/j.polymdegradstab.2012.01.024.
18. ^ Hollingbery, LA; Hull TR (2012). "The Thermal Decomposition of Natural Mixtures of Huntite and Hydromagnesite". *Thermochimica Acta* **528**: 45–52. doi:10.1016/j.tca.2011.11.002.
19. ^ Hull, TR; Witkowski A; Hollingbery LA (2011). "Fire Retardant Action of Mineral Fillers". *Polymer Degradation and Stability* **96** (8): 1462–1469. doi:10.1016/j.polymdegradstab.2011.05.006.
20. ^ Tedesco FJ, DiPiro JT (1985). "Laxative use in constipation". *Am. J. Gastroenterol* **80** (4): 303–9. PMID 2984923.

v · t · e ·	**Magnesium compounds**	[show]
v · t · e ·	**Hydroxides**	[show]
v · t · e ·	**Urologicals, including antispasmodics (G04B)**	[show]
v · t · e ·	**Drugs for acid related disorders: Antacids (A02A)**	[show]
v · t · e ·	**Drugs for constipation (laxatives and cathartics) (A06)**	[show]

Categories: Antacids | Laxatives | Food acidity regulators | Bases | Hydroxides | Magnesium compounds