

Magnesium Carbonate

1 Nonproprietary Names

BP: Heavy magnesium carbonate
Light magnesium carbonate
JP: Magnesium carbonate
PhEur: Magnesii subcarbonas ponderosus
Magnesii subcarbonas levis
USP: Magnesium carbonate

2 Synonyms

See Sections 4 and 17.

3 Chemical Name and CAS Registry Number

Magnesium carbonate anhydrous [546-93-0]
See also Sections 4 and 17.

4 Empirical Formula Molecular Weight

Magnesium carbonate is not a homogeneous material but may consist of the normal hydrate, the basic hydrate, and the anhydrous material MgCO_3 , which is rarely encountered. Basic magnesium carbonate is probably the most common form, and may vary in formula between light magnesium carbonate, $(\text{MgCO}_3)_3 \cdot \text{Mg}(\text{OH})_2 \cdot 3\text{H}_2\text{O}$, and magnesium carbonate hydroxide, $(\text{MgCO}_3)_4 \cdot \text{Mg}(\text{OH})_2 \cdot 5\text{H}_2\text{O}$. Normal magnesium carbonate is a hydrous magnesium carbonate with a varying amount of water, $\text{MgCO}_3 \cdot x\text{H}_2\text{O}$.

See also Sections 8, 13, and 17.

5 Structural Formula

See Section 4.

6 Functional Category

Tablet and capsule diluent.

7 Applications in Pharmaceutical Formulation or Technology

As an excipient, magnesium carbonate is mainly used as a directly compressible tablet diluent in concentrations up to 45% w/w. Heavy magnesium carbonate produces tablets with high crushing strength, low friability, and good disintegration properties.⁽¹⁻⁴⁾ However, magnesium carbonate can have varying effects on dissolution and stability.^(5,6) See also Section 12. Magnesium carbonate is also used to absorb liquids, such as flavors, in tableting processes.

Magnesium carbonate is additionally used as a food additive and therapeutically as an antacid.

See Table I.

Table I: Uses of magnesium carbonate.

Use	Concentration (%)
Absorbent of liquid, in tableting	0.5-1.0
Tablet excipient (direct compression)	≤45

8 Description

Magnesium carbonate occurs as light, white-colored friable masses or as a bulky, white-colored powder. It has a slightly earthy taste and is odorless but, since it has a high absorptive ability, magnesium carbonate can absorb odors.

The USP 25 describes magnesium carbonate as either a basic hydrated magnesium carbonate or a normal hydrated magnesium carbonate. However, the PhEur 2002 describes magnesium carbonate as being a hydrated basic magnesium carbonate in two separate monographs: heavy magnesium carbonate and light magnesium carbonate. The molecular formulas for heavy magnesium carbonate and light magnesium carbonate vary, but heavy magnesium carbonate may generally be regarded as the tetrahydrate $[(\text{MgCO}_3)_3 \cdot \text{Mg}(\text{OH})_2 \cdot 4\text{H}_2\text{O}]$, while light magnesium carbonate may be regarded as the trihydrate $[(\text{MgCO}_3)_3 \cdot \text{Mg}(\text{OH})_2 \cdot 3\text{H}_2\text{O}]$.

The molecular weights of the heavy and light forms of magnesium carbonate are 383.32 and 365.30, respectively.

SEM: 1

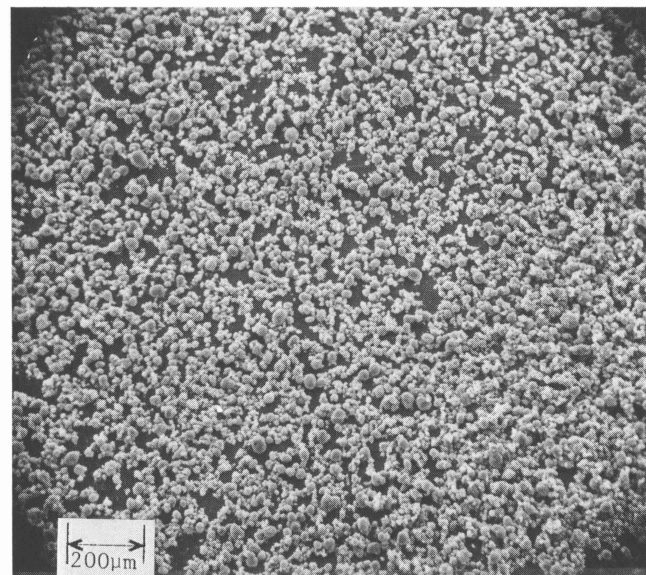
Excipient: Magnesium carbonate USP

Manufacturer: Mallinckrodt Chemicals Co.

Lot No.: KJGJ

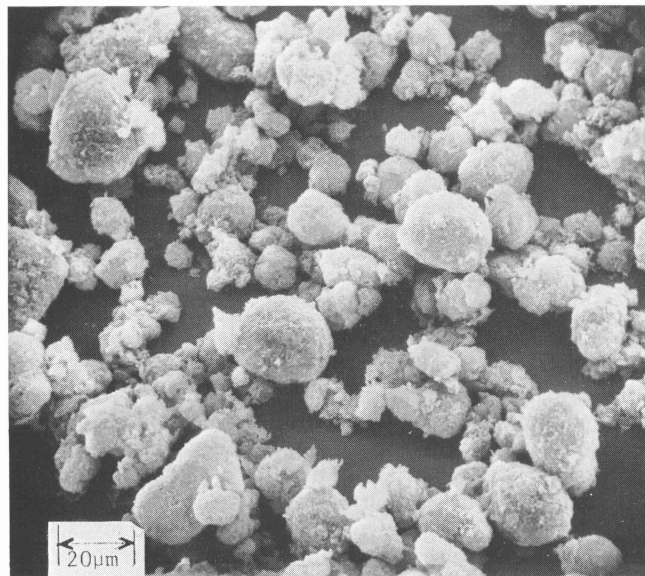
Magnification: 60 ×

Voltage: 20 kV



SEM: 2

Excipient: Magnesium carbonate USP
Manufacturer: Mallinckrodt Chemicals Co.
Lot No.: KJGJ
Magnification: 600 ×
Voltage: 20 kV

**9 Pharmacopeial Specifications**

See Table II.

Table II: Pharmacopeial specifications for magnesium carbonate.

Test	JP 2001	PhEur 2002	USP 25
Identification	+	+	+
Characters	—	+	—
Microbial limits	—	—	+
Color of solution	—	+	—
Soluble salts	≤ 10.0 mg	≤ 1.0%	≤ 1.0%
Acid-insoluble substances	≤ 2.5 mg	≤ 0.05%	≤ 0.05%
Arsenic	≤ 5 ppm	≤ 2 ppm	≤ 4 ppm
Calcium	≤ 0.6%	≤ 0.75%	≤ 0.45%
Heavy metals	≤ 30 ppm	≤ 20 ppm	≤ 0.003%
Iron	≤ 200 ppm	≤ 400 ppm	≤ 0.02%
Chloride	—	≤ 0.07%	—
Sulfate	—	—	—
Heavy magnesium carbonate	—	≤ 0.6%	—
Light magnesium carbonate	—	≤ 0.3%	—
Assay (as MgO)	40.0–44.0%	40.0–45.0%	40.0–43.5%

Note that except where indicated all of the PhEur 2002 test limits apply to both the heavy and light forms of magnesium carbonate.

10 Typical Properties**Angle of repose:**

42–50° for granular heavy magnesium carbonate
 56–60° for spray-dried heavy magnesium carbonate⁽³⁾

Density (bulk):

Heavy magnesium carbonate: ≈ 0.5 g/cm³
 Light magnesium carbonate: ≈ 0.12 g/cm³

Density (tapped): ≈ 0.21 g/cm³ for light magnesium carbonate.

Density (true): 2.054 g/cm³

Moisture content: at relative humidities between 15% and 65% the equilibrium moisture content of heavy magnesium carbonate at 25°C is about 1% w/w; at relative humidities above 75% the equilibrium moisture content at 25°C is about 5% w/w.⁽³⁾

Particle size distribution: 99.95% through a 44.5 μm (#350 mesh) sieve for light magnesium carbonate.

Solubility: practically insoluble in water but soluble in water containing carbon dioxide. Insoluble in ethanol (95%) and other solvents. Magnesium carbonate dissolves and effervesces on contact with dilute acids.

Specific surface area:

7.8–18.2 m²/g for granular heavy magnesium carbonate

4.4–15.5 m²/g for spray-dried heavy magnesium carbonate⁽³⁾

14.64–14.78 m²/g for basic heavy magnesium carbonate

11 Stability and Storage Conditions

Magnesium carbonate is stable in dry air and on exposure to light. The bulk material should be stored in a well-closed container in a cool, dry place.

12 Incompatibilities

Incompatible with phenobarbital sodium,^(4,7) diazepam solution at a pH ≥ 5,⁽⁸⁾ some binary powder mixtures,⁽⁹⁾ and lansoprazole.⁽⁵⁾ Acids will dissolve magnesium carbonate, with the liberation of carbon dioxide. Slight alkalinity is imparted to water. Magnesium carbonate was also found to increase the dissolution of acetazolamide formulations at a pH of 1.12; however, dissolution was retarded at a pH of 7.4.⁽⁶⁾

13 Method of Manufacture

Depending upon the manufacturing process used, the composition of the magnesium carbonate obtained may vary from normal hydrated magnesium carbonate to basic hydrated magnesium carbonate.

Light magnesium carbonate may be manufactured by saturating an aqueous suspension of dolomite (MgCO₃·CaCO₃) with carbon dioxide under pressure. On increase of the temperature, calcium carbonate precipitates almost entirely. The filtered solution is then heated to boiling; the magnesium bicarbonate in the solution loses carbon dioxide and water, and light magnesium carbonate precipitates.

Heavy magnesium carbonate may be manufactured by mixing a hot concentrated solution of magnesium chloride or magnesium sulfate with a solution of sodium carbonate. The heavy magnesium carbonate may be either precipitated to produce a granular material or spray-dried. Varying the temperature of the reaction solutions produces heavy magnesium carbonate with differing physical properties: e.g., material with a higher specific surface area is produced at a lower reaction temperature. Low processing temperature provided the largest surface area, which produced optimum granules or spray-dried powder.⁽³⁾ If dilute magnesium chloride or magnesium sulfate solutions are used for the reaction, a less dense material is produced.

14 Safety

Magnesium carbonate is used as an excipient in oral solid-dosage pharmaceutical formulations and is generally regarded as an essentially nontoxic and nonirritant material. However, the use of magnesium salts, such as magnesium carbonate, is contraindicated in patients with renal impairment.

On contact with gastric acid, magnesium carbonate reacts in the stomach to form soluble magnesium chloride and carbon dioxide. Magnesium carbonate should therefore not be used as an antacid by those individuals whose stomachs cannot tolerate the evolution of carbon dioxide. Some magnesium is absorbed but is usually excreted in the urine. As with other magnesium salts, magnesium carbonate has a laxative effect and may cause diarrhoea.

Therapeutically, the usual dose of magnesium carbonate as an antacid is 250–500 mg, and 2.0–5.0 g as a laxative.

15 Handling Precautions

Observe normal precautions appropriate to the circumstances and quantity of material handled. Magnesium carbonate may be irritant to the eyes; eye protection is recommended.

16 Regulatory Acceptance

GRAS listed. Accepted as a food additive in Europe. Included in the FDA Inactive Ingredients Guide (oral capsules and tablets). Included in nonparenteral medicines licensed in the UK.

17 Related Substances

Magnesium carbonate anhydrous; magnesium carbonate hydroxide; normal magnesium carbonate.

Magnesium carbonate anhydrous

Empirical formula: MgCO_3

Molecular weight: 84.31

CAS number: [546-93-0]

Synonyms: carbonic acid, magnesium salt anhydrous (1:1); E504; magnesite.

Appearance: odorless, white-colored bulky powder or light, friable masses.

Melting point: decomposes at 350°C.

Magnesium carbonate hydroxide

Empirical formula: $(\text{MgCO}_3)_4 \cdot \text{Mg}(\text{OH})_2 \cdot 5\text{H}_2\text{O}$

Molecular weight: 485.65

CAS number: [39409-82-0]

Synonyms: carbonic acid, magnesium salt (1:1), mixture with magnesium hydroxide and magnesium hydrate; E504.

Appearance: odorless, white-colored bulky powder or light, friable masses.

Melting point: on heating at 700°C it is converted into magnesium oxide.

Specific gravity: 1.45

Comments: the EINECS number for magnesium carbonate hydroxide is 235-192-7.

Normal magnesium carbonate

Empirical formula: $\text{MgCO}_3 \cdot x\text{H}_2\text{O}$

CAS number: [23389-33-5]

Synonyms: carbonic acid, magnesium salt (1:1), hydrate; magnesium carbonate, normal hydrate; E504.

Appearance: odorless, white-colored bulky powder or light, friable masses.

18 Comments

The EINECS number for magnesium carbonate is 208-915-9.

19 Specific References

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20 General References

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21 Author

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22 Date of Revision

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