

CALCIUM AND MAGNESIUM. FORMATION OF CALCAREOUS.WATER HARDNESS

40

Ca

CALCIUM

20

Calcium

- **Calcium** is a chemical element with symbol **Ca** and atomic number 20. Calcium is a soft gray Group 2 alkaline earth metal, fifth-most-abundant element by mass in the Earth's crust. The ion Ca^{2+} is also the fifth-most-abundant dissolved ion in seawater by both molarity and mass, after sodium, chloride, magnesium, and sulfate. Free calcium metal is too reactive to occur in nature. Calcium is produced in supernova nucleosynthesis.
- Calcium is essential for living organisms, particularly in cell physiology where movement of the calcium ion into and out of the cytoplasm functions as a signal for many cellular processes. As a major material used in mineralization of bone, teeth and shells, calcium is the most abundant metal by mass in many animals.

Food

- In solution, the calcium ion varies remarkably to the human taste, being reported as mildly salty, sour, "mineral-like", or even "soothing." It is apparent that many animals can taste, or develop a taste, for calcium, and use this sense to detect the mineral in salt licks or other sources. In human nutrition, soluble calcium salts may be added to tart juices without much effect to the average palate.



Ca



Compounds

- Calcium chemistry is almost exclusively that of Ca^{2+} salts. Ca^{2+} is a "hard cation", that is, it characteristically favors oxide ligands. Hence the abundance of carbonates, nitrates, phosphates, and sulfates in the mineral kingdom. Many of these species crystallize with water. Because it is generally nontoxic and abundant, calcium is found in many foods and useful materials. Most calcium salts are colorless. As with magnesium salts and other alkaline earth metal salts, the halides are soluble in water.
- Combined with phosphate, calcium forms hydroxylapatite ($\text{Ca}_5(\text{PO}_4)_3(\text{OH})$), the mineral portion of animal bones, teeth, and some corals. Large-scale chemical processes are involved in the conversion of calcium phosphate minerals into fertilizer.

Geochemical cycling

- This Ca^{2+} eventually is transported to the ocean where it reacts with dissolved CO_2 to form limestone. Some of this limestone settles to the sea floor where it is incorporated into new rocks. Dissolved CO_2 , along with carbonate and bicarbonate ions, are termed "dissolved inorganic carbon" (DIC).
- $\text{Ca}^{2+} + 2\text{HCO}_3^- \rightarrow \text{CaCO}_3 \text{ (limestone)} + \text{CO}_2 + \text{H}_2\text{O}$
Note that at seawater pH, most of the CO_2 is immediately converted back into HCO_3^- . The reaction results in a net transport of one molecule of CO_2 from the ocean/atmosphere into the lithosphere.

24

Mg

MAGNESIUM

12

Magnesium

- Is a chemical element with symbol **Mg** and atomic number 12. It is a shiny gray solid which bears a close physical resemblance to the other five elements in the second column (Group 2, or alkaline earth metals) of the periodic table: all Group 2 elements have the same electron configuration in the outer electron shell and a similar crystal structure.

Mg

12

24.305



Magnesium

Physical properties

- Elemental magnesium is a gray-white lightweight metal, two-thirds the density of aluminium. It tarnishes slightly when exposed to air, although, unlike the other alkaline earth metals, an oxygen-free environment is unnecessary for storage because magnesium is protected by a thin layer of oxide that is fairly impermeable and difficult to remove.

Chemical properties

- Flame temperatures of magnesium and magnesium alloys can reach 3,100 °C (3,370 K; 5,610 °F), although flame height above the burning metal is usually less than 300 mm (12 in). Once ignited, such fires are difficult to extinguish, with combustion continuing in nitrogen (forming magnesium nitride), carbon dioxide (forming magnesium oxide and carbon)





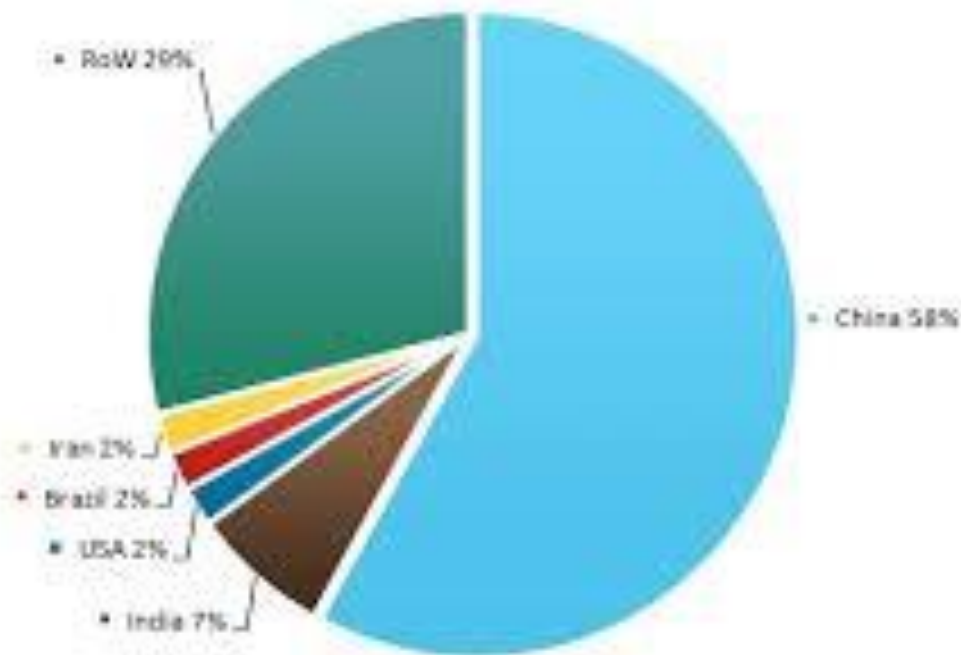
Magnesium



Compounds

- Magnesium forms a variety of compounds important to industry and biology, including magnesium carbonate, magnesium chloride, magnesium citrate, magnesium hydroxide (milk of magnesia), magnesium oxide, magnesium sulfate, and magnesium sulfate heptahydrate

Magnesium Compounds Capacity Globally in 2013



Calcareous

Calcareous is an adjective meaning "mostly or partly composed of calcium carbonate", in other words, containing lime or being chalky. The term is used in a wide variety of scientific disciplines

In botany

Calcareous grassland is a form of grassland characteristic of soils containing much calcium carbonate from underlying chalk or limestone rock. Species of algae such as the green-segmented genus *Halimeda* are calcareous

In zoology

- *Calcareous* is used as an adjectival term applied to anatomical structures which are made primarily of calcium carbonate, in animals such as gastropods, i.e., snails, specifically about such structures as the operculum, the clausilium, and the love dart.
- The term also applies to the calcium carbonate tests of often more or less microscopic Foraminifera. Note that not all tests are calcareous; diatoms and radiolaria have siliceous test
- The molluscs are calcareous, as are calcareous sponges (Porifera), that have spicules which are made of calcium carbonate

In medicine

- The term is used in pathology, for example in *calcareous conjunctivitis*, and when referring to *calcareous metastasis* or *calcareous deposits*, which may both be removed surgically

Calcareous soils

- soils are relatively alkaline, in other words they have a high pH. This is because of the very weak acidity of carbonic acid. Note that this is not the only reason for a high soil pH. They are characterized by the presence of calcium carbonate in the parent material and may have a calcic horizon, a layer of secondary accumulation of carbonates (usually calcium or Mg) in excess of 15% calcium carbonate equivalent and at least 5% more carbonate than an underlying layer



Download from
Dreamstime.com

This watermarked comp image is for previewing purposes only.

ID 4280022

© Gian Marco Valente | Dreamstime.com



Water

Hardness of water is a measure of the total concentration of the calcium and magnesium ions expressed as calcium carbonate.

There are two types of hardness

- 1. Temporary hardness
- 2. Permanent hardness

Temporary Hardness is due to the presence of bicarbonates of calcium and magnesium. It can be easily removed by boiling.

Permanent Hardness is due to the presence of chlorides and sulphates of calcium and magnesium. This type of hardness cannot be removed by boiling.

Water Hardness: Determination with EDTA

- Procedure (Titration of Blank)
 - Use a volumetric pipet to dispense 25.00 mL of deionized water (DI) into a 250 mL flask.
 - Add 5 mL of pH 10 buffer, 2 drops of Eriochrome Black T indicator, and 15 drops of 0.03 M MgCl_2 .
 - Titrate the solution with EDTA from your buret. As you near the endpoint, the solution will turn purple. Continue to **slowly** add EDTA until the solution turns blue, with no trace of red.

beginning
color



nearing
endpoint



endpoint
color



Water Hardness Scale

Grains/Gal

mg/L & ppm

Classification

Less than 1

Less than 17.1

Soft

1 – 3.5

17.1 - 60

Slightly Hard

3.5 - 7

60 - 120

Moderately Hard

7 - 10

120 - 180

Hard

Over 10

Over 180

Very Hard





