

Calcium Carbonate

What is Calcium Carbonate?

Calcium Carbonate is an exceptional mineral. The chemical formula CaCO_3 covers a raw material, which is widespread throughout nature, whether dissolved in rivers and oceans, in molten form as “cold” carbonatite-lava, or solid as a mineral in the form of stalactites, stalagmites or as the major constituent of whole mountain ranges. Plants and animals need calcium carbonate to form their skeletons and shells. In fact, when considering our lives, modern mankind could hardly imagine existing without calcium carbonate. Almost every product in our daily lives either contains calcium carbonate or has some association with the mineral during its production.

The Earth's crust contains more than 4% calcium carbonate. As a result, the three calcium carbonate minerals - calcite, aragonite and vaterite - are among the most important rock-forming minerals. Rocks are not the only calcium carbonate deposits in nature, most stretches of water and countless plants and animals contain huge amounts of calcium carbonate. The link between these natural resources is the calcium carbonate cycle.

Plants and animals absorb calcium carbonate from water - where it exists, in most cases, in the dissolved form of calcium hydrogen carbonate $\text{Ca}(\text{HCO}_3)_2$ - and use it to build up their skeletons and shells. After their death, crustacea, coccoliths, algae and corals form sedimentary deposits on sea-beds, thus the rock forming process is put in motion.

The first stage is the sedimentation process from which chalk and limestone originate. Chalk is a poorly compacted sedimentary calcium carbonate rock, whose diagenesis is incomplete. When the sedimentation process is completed this results in the formation of limestone. If the sedimentation process takes place in magnesium containing water a dolomitisation may occur. Part of the calcium ions in the crystal lattice are replaced by magnesium ions, a fact that leads to the formation of dolomite $\text{CaMg}[\text{CO}_3]_2$. Marble is a metamorphic rock, which is the result of a recrystallisation process of limestone, under conditions of high pressure and temperature. The carbonate rocks, chalk, limestone, dolomite and marble rocks are subject to erosion, under the influence of wind, temperature and water they dissolve, and the cycle may start again.

Multiple properties – manifold uses

Calcium carbonate rocks are spread throughout the world, which is why they have been among the most widely used



raw materials for more than 5000 years. Long ago, the Egyptians built their pyramids with limestone, and today we still use hundred of millions of tonnes of calcium carbonate in the building industry alone. However, although the deposits are plentiful, only a few are of sufficiently high quality to be worked and even a fewer number of deposits will provide raw materials for industrial and agricultural uses other than the construction and roads building industry. Only if the purity, degree of whiteness, thickness and homogeneity are acceptable is commercial extraction worthwhile. After quarrying, further treatment is required to process natural calcium carbonates of the highest quality, known generically as Ground Calcium Carbonate (GCC). Precipitated Calcium Carbonate (PCC) is a synthetic calcium carbonate produced industrially by means of a recarbonisation process.

Both GCC or PCC can be used in a wide range of applications. For each end use there exists a tailor-made product, where fineness and particle size distribution are optimally balanced to meet the technical demands of that particular requirement.

- **Paper:** Over the last 30 years, the use of calcium carbonate has grown significantly as technology in the paper industry has moved from acid to neutral sizing. Today, calcium carbonate is the most widely used mineral in paper-making. GCC and PCC are used both as a filler and a coating pigment, and help produce papers with high whiteness and gloss and good printing properties.

- **Plastics:** Calcium carbonate is by far the most important mineral for compounding with polymers. By weight it accounts for more than 60% of the filler and reinforcements market. Main applications include plasticised and rigid PVC, unsaturated polyesters, polypropylene and polyethylene. Other important areas of use include rubber, foamed latex carpet-backings, sealants and adhesives.

Calcium carbonate is not only a filler added to reduce costs and extend petroleum based resources, many properties of the plastic can be influenced by the use of calcium carbonate. Breathable PE-films for hygiene products and the building industry, for example, can only be produced with the incorporation of a filler such as calcium carbonate.

- **Coatings:** In paints and coatings, calcium carbonate has established itself as the main extender. Fineness and particle-size distribution can contribute to the opacity of coatings. Moreover, calcium carbonate can offer improvements in weather resistance, anti-corrosion and rheological properties, coupled with low abrasiveness, low electrolyte content, and a pH stabilising effect. In water-based systems calcium carbonate reduces the drying time.
- **Environment:** As a natural product, calcium carbonate is perfect for environmental protection applications. For example, flue gas desulphurisation, drinking water treatment, waste water treatment and forest and lake liming for the neutralisation of acid rain, are all growth areas for the use of calcium carbonate. It has a natural buffer-effect and works as a pollution-filter. These properties, likewise, apply to the derivative products.
- **Agriculture:** Calcium fertilisers were one of the first to be widely used. The Greeks and Romans were aware of their attributes. Their use guarantees an adequate supply of calcium to plants and stabilises the pH-value of the soil. These characteristics make calcium carbonate an

important fertiliser for the agriculture and forestry sectors. Every year, in Europe alone, more than 4.5 million tonnes are supplied to this market. Other agricultural-related uses of calcium carbonate include its use as a calcium supplement in animal feed compounds.

- **Construction/Architecture:** Calcium carbonate has found an innovative application in the concrete market. It is increasingly used as a quality filler in concrete applications, such as concrete wares (paving-stones, tubes, sewage-tanks), ready-mixed concrete and prefabricated elements. It improves the concrete density, pre-stability and durability. Its stable colour quality increases the aesthetics which make it very suitable for architectural applications.
- **Others:** Glass, ceramics and blackboard chalk, together with cleaning, dental care and cosmetic products are produced by the wide range of industrial manufacturers who rely on calcium carbonate. As a natural mineral, calcium carbonate has a multitude of characteristics that make it an ideal raw material for widely differing uses. No one calcium carbonate is exactly like another, whichever property is needed a high grade product is there to meet the demand. Diverse requirements such as low iron oxide content for the production of high-quality glasses, the authorisation for uses in foodstuffs, good buffering-effect or low abrasion, can be met by an existing grade of calcium carbonate.

For more information, please contact:

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