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Characteristics / functions:

Calcium carbonates, also called calcite or calcareous spar, are the most common minerals on earth, following quartz.

Chemical formula: CaCO₃, hardness 3, according to Mohs, specific gravity 2.6 - 2.8. glass shine, going from transparent to intransparent. Color: white grey, yellow, reddish, brownish, green, colorless.

Line: white (colored when heavily polluted), broken: shell-like, brittle, complete cracking-ability, strong sparkling when mixed with cold, diluted hydrochloric acid due to the development of carbonic acid. Appearance in limestone as mixture or as a binder in various sandstones.

The most important calcium carbonates are:

Calcite:

Colorless, clear, transparent, easily crackable, coarse and white fine grained, dense crystals. Especially the latter form of calcite is softer and less abrasive, due to its less splinter-shaped particles.

The large consumption is mainly caused by its perfect all-round qualities: low need of binders, weather resistant, physiological harmless and low price

Main applications: plastics, putty, fillers, adhesives, rubbers, ground coats, silk gloss varnishes, dispersion paint, printing ink and paper industry.

Chalk:

Hardly solidified, consists of fine calcite crystals and calcite fractures, caused by the shells and body parts of nanofossils. Large deposits in Europe can be found at the Canal coast and around Paris.

Due to its loose structure with a strong suction ability of humidity and its extreme sensitivity against acids, the applications are limited (interior paints).

Chemical components of natural calcium carbonates:

The natural calcium carbonates (calcite, chalk, limestone, marble) should have the following values:

- CaCO₃ 98.50 - 99.00 %
- MgCO₃ max. 0.50 %
- Fe₂O₃ max. 0.20 %
- lightness 85.00 - 95.00 %

The purer it is, i.e. the lower the percentage of iron and other heavy metals is, the higher is the lightness.

Concerning the quantity, calcium carbonates are the most important fillers.

Quality of carbonate fillers:

Calcium carbonate fillers are available in various fineness' to cover the main part of the applications. These fineness' go from a d50- value of around 1.0 - 1.5 µm and a particle size of 6 - 10 µm up to splinter shaped forms measured in mm. The specific surfaces of fine grinding are between 1 and 10 m²/g (10 m²/g is only for the finest materials.)

The oil absorption values, characterizing the absorption of binders, have values between 9 and 30g/100g, depending on the fineness.

Today it is even possible to provide special materials without negative side effects, like abrasion on machines. Furthermore, one can give the calcium carbonate a special lipophil character, by a special surface treatment (coating); used in the thermoplastic industry.

Application for plastics:

Finest ground chalks are often used in the PVC- industry. The inactive CaCO₃-filler is important for the balance between a low purchasing price and the maintenance of the physique-mechanic values. High quality carbonate extenders have the following positive properties:

- high chemical purity,
- no heavy metal ions which catalyze the aging process,
- no tendency to agglomeration,
- calcite-like structure with a relatively low specific surface without an absorption of plasticizations and additives,
- high whiteness ==> substitute for TiO₂ - white pigments,
- abrasion resistant,
- high dispersibility (especially coated types), low influence on mechanical and electrical values of the final product,
- rise of the rigidity and of the E- modulus,
- reduction of contraction,
- improvement of the surface of the product,
- acceleration of working speed,
- reduction of plate-out in the processing machines (deposit of mixed particles),
- rise of impact resistance, especially coated types,
- cheaper than precipitated CaCO₃, therefore advantageous increase of volume and weight.

Polyamides filled with carbonate cause a reduction of the raw material price. They are used in industries where a good dimension stability is required, without contraction problems (household machines, washing machines, automobiles).

Qualities of these moulding materials: Very good surface quality, high heat resistance, good stiffness and tenacity and resistant against many solvents, fuel, oils and greases.

Application for paints and varnishes:

The above mentioned properties of calcium carbonates are also a base for the **use in paints and varnishes**.

Worth being mentioned: physiological harmlessness, low natural color, **weather resistance and the compatibility with other pigments**. Therefore, it can be used as the only extender in white and colored varnishes.

Application for paper industry:

Due to the permanent price increases of kaolin, CaCO₃ became more and more important as a filler. The reason for this phenomenon lies in the expensive disintegration of kaolin and high freight costs. Calcium carbonate, however, is almost pure in its appearances and does not cause high costs for disintegration.

By using CaCO₃ in the neutral area, one can reach special advantages compared to the sour process:

- improvement of the whiteness of the paper by saving other optical brighteners,
- rise of strength despite a higher percentage of fillings,
- saving of grinding energy because of a smaller material milling, less corrosion,
- less water pollution,
- higher aging resistance of the paper,
- saving of costs for auxiliary substances.

Precipitated CaCO₃ is used only as a filler for special papers, like cigarette paper.

Bibliography:

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- Geächter/Müller: Kunststoffadditive/3. Ausgabe 1990

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