

What is kaolin?

Kaolinite is a mineral belonging to the group of aluminosilicates. It is commonly referred to as "China Clay" because it was first discovered at Kao-Lin, in China. The term kaolin is used to describe a group of relatively common clay minerals dominated by kaolinite and derived primarily from the alteration of alkali feldspar and micas. Kaolin is an industrial mineral used primarily as an inert filler and customers combine it with other raw materials in a wide variety of applications.

Kaolin is a white, soft, plastic clay mainly composed of fine-grained plate-like particles. Kaolin is formed when the anhydrous aluminium silicates which are found in feldspar-rich rocks, like granite, are altered by weathering or hydrothermal processes. The process which converted the hard granite into the soft matrix found in kaolin pits is known as "kaolinisation". The quartz and mica of the granite remain relatively unchanged whilst the feldspar is transformed into kaolinite. Smectite may also form in small quantities in some deposits. The refining and processing of the fine fraction of the kaolinised granite yields predominantly kaolinite with minor amounts of mica, feldspar, traces of quartz and, depending on the origin, organic substances and/or heavy minerals.

Individual kaolins vary in many physical aspects, which in turn influence their end use. Of particular commercial interest is the degree of crystallinity which influences the brightness, whiteness, opacity, gloss, film strength, and viscosity.

Multiple properties – manifold uses

Kaolin is part of our natural world. Its uses are multiple and diversified. Kaolin's whiteness and plasticity make it extremely suitable for its extensive use as a filler, extender, ceramic raw material and pigment. It is also an important raw material to refractories, and to catalyst, cement and fibre glass industries.

Kaolin is used in many applications. It is a unique industrial mineral, which remains chemically inert over a relatively wide pH range and it offers excellent covering when used as a pigment or extender in coated films and filling applications. In addition, it is soft and non-abrasive and has a low conductivity of heat and electricity.

The two largest applications of kaolin are the coating of paper to hide the pulp strands and the production of high-grade ceramic products. It is also used in many other industrial processes:



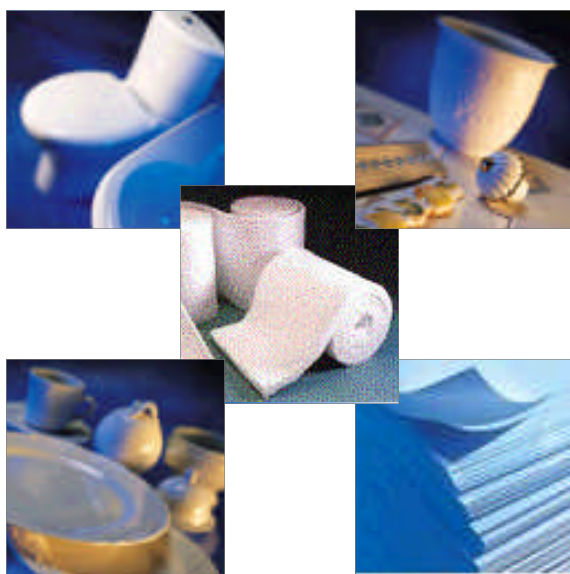
- **Paper:** In this industry, kaolin is used both as a filler in the bulk of the paper and to coat its surface. Kaolin's whiteness, opacity, large surface area and low abrasivity make it an ideal raw material for paper production. Its use allows a reduction in the amount of expensive wood pulp required, enhances the optical properties of the paper and improves its printing characteristics. When used as a coating on the surface of the paper, kaolin's whiteness improves paper brightness and opacity, whilst the size and the shape of the individual kaolin particles give the gloss and printed paper quality required for many different kinds of paper. Examples include papers for magazines and brochures, art paper, cartons and boxes etc.

- **Ceramics:** Kaolin converts to mullite and glass when fired to temperatures exceeding 1000° C. It is used in formulations described as **whitewares**, which consists of tableware, sanitaryware, and wall and floor tiles. It provides strength and plasticity in the shaping of these products and reduces the amount of pyroplastic deformation in the process of firing.

In **tableware**, in addition to the strength and plastic qualities, it is essential to the achievement of high fired whiteness. This is because it contains a low content of colouring elements such as iron and titanium.

For **sanitaryware**, the product is formed by casting (either in plaster, or resin moulds under pressure). Kaolin contributes the rheological properties that enables the casting slip to flow and drain after the cast formation. The cast pieces are relatively heavy and the kaolin must be strong to withstand the weight and retain the shape before the pieces enter the kiln.

- **Fillers:** When kaolin is used as a pigment, it is divided broadly into filler- and paper coating grade clays based on their brightness and viscosity. Its main properties, especially its whiteness or near whiteness, make it very suitable as a filler or pigment. In addition, it remains inert over a wide PH range, is nonabrasive, has a low heat and electrical conductivity and offers brightness and opacity.
- **Paint:** In its hydrous or calcined forms, kaolin can improve the optical, mechanical and rheological properties of a paint. Calcined kaolins are widely used in satin and matt paints where they can deliver increased opacity, whiteness and scrub resistance. Kaolin is particularly useful as a partial replacement for TiO₂ pigment.
- **Rubber:** Kaolin adds strength, abrasion resistance and rigidity to rubber. Calcined kaolin in particular, with or without a silane chemical surface treatment, finds extensive use in high value thermoplastic elastomers for a variety of applications and in rubber insulation on high voltage power lines.
- **Plastics:** Kaolin is used in plastics to provide smooth surfaces, dimensional stability and resistance to chemical attack, to conceal fibre reinforcement patterns and to reduce shrinkage and cracking during polymer compounding and shape forming. It is also used as a rheological modifier and a functional filler, in which capacity it is used to improve mechanical, electrical and thermal properties. A major application is in PVC cables where its main function is to improve electrical properties. Other important applications include



specialty films where they impart anti-blocking or infra-red absorption characteristics. Chemically treated, calcined kaolins is one of the major additives used in the manufacture of automotive parts based on engineering thermoplastics.

- **Refractories:** Refractories are produced from natural materials, combinations of compounds and minerals, such as kaolin, which are used to build structures subjected to high temperatures, ranging from simple to sophisticated products, e.g. from fireplace brick linings to re-entry heat shields for the space shuttle. In industry, they are used to line boilers and furnaces of all types-reactors, ladles, stills, kilns and so forth.
- **Fibreglass:** The fibreglass which is used as a strengthener in a multitude of applications requires the use of kaolin for its manufacture. Kaolin allows for the strengthening of the fibres integrated into the material. It also improves the integration of fibres in products requiring strengthened plastics: cars, boats and marine products, sporting goods and recreation products, aviation and aerospace products, circuit board manufacturing, fibreglass insulation, fibreglass air filters, fibreglass tanks and pipes, corrosion resistant fibreglass products, fibreglass building and construction products, etc.
- **Cosmetics and pharmaceuticals:** 'British Pharmacopoeia Light Kaolin' (BPLK) and 'Heavy Kaolin' are manufactured according to the requirements of the British and European Pharmacopoeia respectively. BPLK is used in both human and veterinary medicinal products, for example to treat digestion problems and as a constituent of poultices. It can also be used as an excipient in personal care products including, for example, Thalasso therapy (bath and skin treatments) and in cosmetics. Additionally, BPKL is found in a number of dietary products, plasters, foot-powders and in the specialised treatment of some lung disorders.

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