

Calcium Chloride *Market Reviews*

Industrial Uses

3 Cement Production

Calcium chloride is an additive that reacts with sodium (Na) and potassium (K) alkali impurities in cement. This reduces the alkali-aggregate reactions in cured cement that cause expansion and premature deterioration of finished concrete structures.

DESCRIPTION

Concrete is a composite of aggregate and sand bound by portland cement. Its ability to resist freezing and thawing, chemical attack, abrasion and corrosion determines the life of concrete structures. While external factors can be designed for, damage by reactions in the binder is more difficult to prevent.

Alkali-aggregate reaction (AAR) occurs when silicates (e.g., shale, clay or limestone) in the aggregate reacts with soluble Na and K alkalis in the cement. This forms a gel that absorbs water and can expand and crack concrete (causing 'surface map pattern cracks'). These reactions are typically controlled by using a non-reactive aggregate, a mineral admixture like fly ash or silica fume, or a low alkali cement. Calcium chloride is used in the production of low alkali portland cements to provide chloride ions that greatly reduce the level of soluble Na and K alkalis.

APPLICATION

Portland cement is made by wet and dry processes from such materials as limestone for calcium, shale or clay for aluminum, iron ore for iron, and silica sand or slag for silica. The materials are finely ground, proportioned, blended, fed to a rotary kiln and heated to 2,700°F (1,489°C). The partially fused material (or clinker) is ground to a fine powder (98.5% passes a 200-mesh screen). Gypsum may be added during grinding to control the rate of set.

Na and K alkalis appear as impurities in the raw material, usually in shale or clay. Although most of these alkalis are volatilized in the kiln as silicates, sulfates or oxide salts, the alkali content of clinker often exceeds 0.6% as Na₂O. Addition of CaCl₂ during burning can significantly reduce alkali level because Na and K salts are more volatile as chlorides.

Low-alkali portland cement has no more than 0.6% alkali, expressed as Na₂O. In addition to increasing how much and how fast alkalis are volatilized, CaCl₂ also produces low-alkali clinker at low-burning temperatures, extending the life of burning zone refractories. CaCl₂ can be added by:

- Spraying it as a liquid into the firing end of the kiln under the flame (or burner pipe). This provides ease of handling, controls application rates, lessens the control needed for raw-mix proportions, and allows alkali level to be fine-tuned.
- Spraying it onto raw materials before they are crushed in the roller mill. This also provides ease of application and control of application rates.
- Spraying it into the top of the pre-calciner.
- Mixing it as flake CaCl₂ in raw materials before the preheaters. This works well for dry processes.
- Spraying it into the raw material slurry in the few wet kilns still functioning. This involves ease of handling and mix proportioning, but it can cause mill scale.

Calcium chloride addition rate is based on analysis of the clinker. Factors that affect addition include the amount and kind of alkali present, the length of the kiln and its burning zone, and the amount of dust recycled. In general, the amount of alkali removal needed is proportional to the CaCl₂ added.

CEMENT GLOSSARY

CEMENT – A chemical binder (glue, paste, etc.) that adheres bodies to each other. **CLINKER** – The fused product of a kiln ground to make cement.

DRY PROCESS – Cement process in which dry raw materials are ground, conveyed, blended and stored. **FINISH GRINDING** – The grinding of clinker into finished cement.

FINISH MILL – Usually a tube or ball mill for final clinker grinding.

HYDRAULIC CEMENT – An adhesive that sets and hardens when mixed with water due to reactions between water and the cement.

KILN – Equipment in which cement raw mix is dried, calcined, and burned into clinker at 2600 to 3000° F. Kilns can be a rotary or shaft type and use coal, oil, gas or other fuel.

PORTLAND CEMENT – A hydraulic cement made by pulverizing clinker having hydraulic calcium silicates, usually with calcium sulfate as an interground addition. Usually gray in color. (See White Cement).

POZZOLANS – Finely divided siliceous or siliceous-aluminous material that reacts with slaked lime in the presence of moisture to form a strong, slow-hardening cement.

PRECALCINER – Uses preheated combustion air from the clinker cooler and/or kiln exit gases with separate burners to calcinate up to 95% of the raw material.

PRECALCINER KILN SYSTEM – A rotary kiln with an external furnace for heating cement raw meal to calcination temperature. It often has a multistage cyclonic preheater.

PREHEATER – Heater for cement raw meal or slurry located before the rotary kiln to aid fuel economy.

ROTARY KILN – A cylindrical kiln that burns cement raw meal into clinker. It is divided into zones for drying (wet process), preheating, calcining, burning, and cooling. Kilns having a preheater and/or pre-calciner do not usually contain the first three zones.

WET PROCESS – Grinding, blending, mixing and pumping raw materials is done with water. Used if raw materials are so wet and sticky that drying is difficult and costly.

WHITE CEMENT – Cement, conforming to portland cement specs, made from low-iron raw materials (such as kaolin) and specially burned to reduce coloring by trace elements.

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