

## Calcium Chloride *Market Reviews*

### Industrial Uses

## 5 Concrete Accelerator

Calcium chloride accelerates the hydration of cement, which reduces initial and final set time and shrinkage while increasing early strength, surface wear, cold weather protection and workability. It is used in many industry segments, including by manufacturers of ready-mixed concrete, concrete block and pipe and precast products. It is also used by paving contractors, engineering firms and construction companies, especially those specializing in concrete placement.

#### DESCRIPTION

Calcium chloride provides many advantages when added to concrete. It speeds set time, strengthens concrete in less time, and makes it easier to use concrete at low temperatures. It also aids curing, workability and density and creates a wear-resistant surface.

#### Set Time

When  $\text{CaCl}_2$  is added to portland cement at normal conditions (i.e., 70°F), it lowers initial set time from 3 hours to 1 hour, and final set from 6 hours to 2 hours. Set time increases as temperatures fall below normal.

#### Strength

It also more than doubles one-day concrete strength at 70 °F. Concrete strength is 51% higher at three days and 32% higher at seven days. It also can improve ultimate strength. The Portland Cement Association found  $\text{CaCl}_2$  improve ultimate strength 9% in 3 years, and the California Department of Public Works found it improves strength 10% in 5 years.

#### Cold Weather Protection

While  $\text{CaCl}_2$  causes strength to develop in half the usual time at 70°F, its effect at lower temperatures is more pronounced. For example, at 40°F it gives cured concrete a one-day strength equal to plain concrete at three days. At two days, its strength equals that of plain concrete after 5 to 6 days.

Standard cold weather protective measures are needed with concrete containing  $\text{CaCl}_2$  and entrained air, e.g., insulated forms or heated enclosures.  $\text{CaCl}_2$  shortens the time protection is needed, however.

Calcium chloride is often added when temperatures fall below 50°F at some time in the 24 hours after concrete placement. Protection should last at least 48 hours after the first frost and until mean daily temperature is less than

40°F. When mean daily temperature is below 40°F, mix and place the concrete at 55°F or more and hold this temperature for three days. Then protect the concrete from freezing for three more days.

#### Curing

When addition of  $\text{CaCl}_2$  is combined with draping wet burlap on the concrete overnight to provide adequate moisture,  $\text{CaCl}_2$  aids curing by:

- Halving moisture loss early in hydration by lowering evaporation.
- Releasing the heat of hydration sooner.
- Accelerating hydration, which reduces the time needed for curing and protection.

**Workability and Density**

CaCl<sub>2</sub> increases concrete flow and workability without a change in the water/cement ratio. Alternatively, it allows for greater density by reducing water content up to about 0.5 gal./bag of cement.

**Resistance to Wear and Surface Curing**

CaCl<sub>2</sub> improves concrete durability. National Bureau of Standards tests show that it substantially increases resistance to surface wear. Resistance in specimens cured with CaCl<sub>2</sub> were 25% to 66% more resistant than those from three other methods and were 50% more than specimens that were not cured. The CaCl<sub>2</sub> specimens had a surface wear comparable to those with standard wet curing.

Surface curing adds concrete with CaCl<sub>2</sub> to the surface of concrete after it has cured overnight. This gives slabs a more wear-resistant surface and is especially useful when slabs must be opened early.

**APPLICATION**

CaCl<sub>2</sub> is normally added to the mixing water or aggregates at a rate of 1% to 2% in the mixing drum as a solution (see methods for making standard solutions below). It also can be added to mixed concrete just before discharge (allow at least 20 revolutions of the mixer drum). The amount of flake CaCl<sub>2</sub> or its equivalent in a standard solution should not exceed 2 lb./sack of cement (2%).

For ready-mixed concrete, add CaCl<sub>2</sub> at the plant if the concrete is to be discharged within an hour after the start of mixing. If not, add CaCl<sub>2</sub> at the destination, allowing about 1 minute for mixing or 20 revolutions of the mixer. The proper amount for a batch can be prepackaged and either sent with the truck or stored on site.

**STANDARD SOLUTIONS**

A standard solution contains one lb. flake CaCl<sub>2</sub>/qt. solution. It can be prepared in two ways:

**Method 1:** Use this when preparing a set amount of final solution. It gives 4 lb. CaCl<sub>2</sub>/gal. final solution. Here's a typical example:

- Step 1: Fill a 1,000-gallon tank 2/3 full of water.
- Step 2: Slowly add 40 100-lb. bags of flake CaCl<sub>2</sub> while stirring.
- Step 3: Stir until all CaCl<sub>2</sub> is dissolved.
- Step 4: Fill tank with water and stir again.

**Method 2:** Add CaCl<sub>2</sub> to a known amount of water, e.g., 5 lb. flake CaCl<sub>2</sub>/gal. water. For a large quantity:

- Step 1: Meter 600 gal. water into a 1,000-gallon tank.
- Step 2: Slowly add 30 100-lb. bags of flake calcium chloride while stirring.
- Step 3: Continue to agitate until the CaCl<sub>2</sub> is completely dissolved.

To make a small quantity:

- Step 1: Fill a 55-gallon drum 2/3 full of water.
- Step 2: Slowly add 2 100-lb. bags of CaCl<sub>2</sub> while stirring.
- Step 3: Stir until completely dissolved.
- Step 4: Fill with water to the 50-gallon level and stir again.

**TIPS FOR USING CALCIUM CHLORIDE**

- Add the CaCl<sub>2</sub> to water. Do not add water to CaCl<sub>2</sub>, because this can form a hard coating that is difficult to dissolve.
- Do not use more CaCl<sub>2</sub> than recommended, because this adds too much CaCl<sub>2</sub> to the mix or raises the temperature at which the solution crystallizes.
- Do not fill tanks completely before adding CaCl<sub>2</sub>, to allow enough volume for the final solution.
- Calcium chloride develops heat as it dissolves. Allow solutions to cool before using them.
- Stir with a small mechanical mixer or air lance when preparing the solution.
- If solution is made in drums, keep a clean, empty drum nearby. Make more solution in the empty drum before it is needed to avoid calculating partial quantities.

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