



Calcium Chloride

A Guide to Handling and Storage

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About This Guide

This guide presents general information pertaining to the handling and storage of calcium chloride products from Occidental Chemical Corporation (OxyChem). It is intended to complement other OxyChem literature on calcium chloride products. It is not intended to serve as a complete and comprehensive technical reference for the topics presented. It is the responsibility of the end user to determine the most appropriate way to apply this information to their specific situation.

OxyChem publishes and regularly updates Material Safety Data Sheets (MSDS) for each calcium chloride product it produces. These documents provide information on health and handling precautions, safety guidelines and product status relative to various government regulations.

Obtain Material Safety Data Sheets and other product and application information at www.oxycalciumchloride.com.

Safe Handling and Storage

To successfully handle and store liquid and dry calcium chloride, it is important to understand that five product attributes strongly influence most of the recommended practices.

1. Calcium chloride is hygroscopic. It is capable of absorbing moisture from the air. This can cause clumping and caking in dry calcium chloride products, such as pellets, flakes and briquettes.
2. Calcium chloride is deliquescent. Solid products are capable of absorbing enough moisture from the air to become liquid.
3. Calcium chloride has an exothermic heat of solution. Solid products release a large amount of heat when dissolved in water.
4. Chlorides in the presence of water and oxygen are associated with the accelerated corrosion of common metals, such as steel, copper and brass.
5. Calcium chloride brines are electrically conductive. There is a risk of electric shock if energized electrical equipment is handled with hands or fabric gloves that are wet with brine.

Personnel must be familiar with the contents of the MSDS and abide by the guidelines contained therein. End users are responsible for maintaining full compliance with federal, state, provincial and local requirements applicable to handling and storing calcium chloride.

Packaged Products

Package types. Solid calcium chloride products come in a variety of package types, including bags, boxes, pails, drums and Flexible Intermediate Bulk Containers (FIBCs).

1. Bags are made of plastic or multilayered paper containing a moisture barrier. The bag closure is either a valve-type* or heat-seal.
2. Boxes are constructed of cardboard with a plastic liner that is sealed with a twist tie.
3. Pails are heavy-duty plastic with snap-on lids.

*An internal plastic flap that is pressed against the top panel by the product in the bag.

4. Drums are standard 50-gallon steel with a removable top held in place with a clamping ring.
5. FIBCs have a woven polymer exterior, a plastic liner and a bottom spout for unloading.

Packaged products are delivered on wooden pallets, and most are either covered with a plastic shroud or stretch-wrapped. Available package type, size and pallet configuration will vary by product.

Packaged product handling. Packaged products are shipped via flatbed truck, enclosed van, intermodal container or boxcar. Pallets loaded onto a flatbed truck should be fully covered by tarps to maintain the cleanliness and integrity of the packaging and to keep the load secure while in transit.

A full pallet of product requires a forklift or pallet jack to lift and move. Pallets are typically four-way, meaning that they may be lifted from all four sides. The exceptions to this are those carrying FIBCs or drums, which are two-way only.

Product inventory should be managed on a first-in, first-out basis to minimize the chance of quality issues arising from moisture absorption that occurs over time. If a bag becomes damaged, it should be mended and used ahead of others.

Packaged product storage. Palletized product covered by an intact plastic shroud may be stored outdoors on a well-drained, asphalt or concrete surface. If the shroud is torn, pierced or removed, the palletized product should be stored indoors or under a waterproof tarp. Products packaged in boxes, drums or FIBCs are typically not shrouded. Therefore, these packages should be stored indoors or under a waterproof tarp. Palletized pails are stretch-wrapped, but not shrouded. Because pails are watertight, they may be stored outdoors without a waterproof covering.

Full pallets of bags can typically be stacked three high in a 2-2-1 configuration, with the top row straddling the center line of the first two rows. Pallets of pails, boxes or drums may be stacked three high and two wide (2-2-2). Pallets of FIBCs are typically stacked two high and two wide (2-2).

Individual packages should be stored indoors in a dry area. Unused bags with a valve-type closure should lie flat so that product presses the valve against the top panel of the bag to maintain a seal. Any package that has been opened, but only partially used, must be tightly resealed to prevent exposure to humid air that may lead to caking and liquid brine formation.

Bulk Solid Shipment Modes

Bulk shipments are made in hopper cars of approximately 90 tons and in hopper trucks of various capacities.

Bulk solid handling. Bulk solid calcium chloride may be unloaded and transported by a number of different methods, including drag chains, screw conveyors, pneumatic conveyors, bucket elevators and belt conveyors. The most effective handling equipment is mechanically reliable while minimizing potential detrimental impacts from attrition, exposure to humid air and dust emissions.

Hot-dipped, galvanized and stainless steels are materials that have been shown to work well for solids-handling equipment operating at ambient temperatures. After formation of a rust-colored surface layer, these materials are resistant to generalized corrosion. Stainless steels may not be suitable for handling hot, bulk solids (>100°F [>38°C]), since they are susceptible to chloride stress cracking at elevated temperatures.

Bulk solid storage. To prevent caking and clumping problems in storage, the hopper design should minimize product exposure to humid air. If uniform particle-size distribution is important, the design should take into consideration the effects of hopper configuration on particle-size segregation, because sifting occurs when filling a bin. The fine particles sift through the coarse particles, allowing the fines to concentrate in the center, while the coarse particles roll or slide to the outside. In a poorly designed hopper, solids will empty from the center of the pile while solids on the sides remain stagnant. In a well-designed “mass flow” hopper, all solids move downward together as the hopper is emptied, helping to maintain a more uniform particle-size distribution.

The preferred material of construction for large hoppers is carbon steel with an internal epoxy-based lining and an exterior epoxy-based paint. Stainless steels that are resistant to stress cracking are effective for smaller, surge hoppers, such as those that provide surge capacity for packaging systems. A rust-colored surface layer forms on the stainless steel; however, generalized corrosion under ambient conditions is low. Nonmetallic materials, such as fiberglass and common plastics, will not corrode in calcium chloride service; however, their structural integrity could be in jeopardy from the heat release associated with dissolving solids if it becomes necessary to wash a large quantity of solids from the vessel.

Bulk liquid shipment modes. Bulk liquid calcium chloride is available in concentrations from 28 percent to 42 percent by weight. Product is delivered by tank truck or tank car.

The configurations of transportation equipment and unloading stations vary on a case-by-case basis. An overview of important considerations is provided below; however, it is the responsibility of the end user to develop detailed procedures that are safe, effective in their particular situation and in full compliance with applicable regulations.

Bulk liquid handling. As calcium chloride concentration increases, so does the crystallization temperature (freeze point) of the solution. When the ambient temperature is lower than the freeze point, handling equipment must be designed to keep the product warm (insulation, heat tracing) and/or to drain completely empty when out of service (sloped lines, drains at low points). Freezing points for a few typical concentrations are provided below. For more information, refer to “Calcium Chloride: A Guide to Physical Properties”, available at www.oxycalciumchloride.com.

CaCl ₂ concentration	32%	35%	38%	42%
Freezing pt. °F	-17	+20	+48	+69
Freezing pt. °C	-27	-7	+9	+21

Safe Handling and Storage

Tank trucks and tank cars that carry calcium chloride solutions are normally unloaded through a bottom outlet using a fixed pump to transfer the solution to a storage tank (Figures 1 and 2). A thick-walled, flexible hose is typically used to connect the unloading pump to the outlet valve. The design of the unloading system will depend on the desired unloading time, distance to storage, elevation change, available utilities and other situation-specific factors.

Failure to properly vent the sending and/or receiving tanks during liquid transfer can result in rupture or collapse of the tank. For a tank truck or tank car, it is recommended that the vent valve be open AND the manway be propped open. **CAUTION:** Do not attempt to open the manway cover unless it is certain that the tank truck or tank car is NOT under pressure.

Tank trucks and tank cars usually have both an internal and external valve on the outlet. If either valve is difficult to turn, it may be frozen in place with crystallized calcium chloride. Attempting to force open a frozen valve may result in equipment damage. If crystallization is suspected, blowing steam or warm air on the exterior of the piping is recommended to melt the frozen product and free up the valve.

Air pressure may be used instead of a pump to unload from the bottom or top outlets; the latter of which depends on the presence of an internal dip pipe (Figure 3). The air supply must be regulated at a maximum of 50 psig or below the pressure rating of the tank and its relief device, whichever is lower. When unloading is complete, air pressure in the tank will drop and the sound of air rushing through the unloading line is heard. All pressure must be vented from the tank truck or tank car before releasing it for return transit.

Some tank trucks and tank cars are insulated and fitted with steam coils to allow heating the product prior to off-loading. To prevent equipment damage, the following precautions should be taken when applying steam:

- Increase coil pressure gradually, keeping maximum steam pressure below 150 psig.
- Keep calcium chloride solution temperature well below 170°F (77°C).

- Shut off steam to the coils after 1/4 of the solution has been unloaded.
- Blow steam coils empty after use to prevent freezing of residual water while in winter transit.
- Do not attempt to increase product temperature by blowing steam directly into the liquid.

Figure 1: Unloading of Tank Truck by Pump

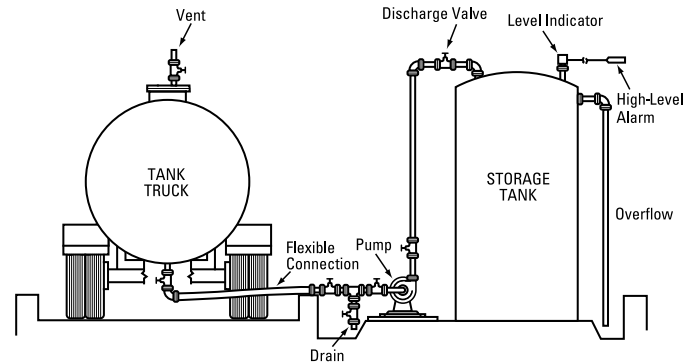


Figure 2: Unloading of Tank Car by Pump: Bottom

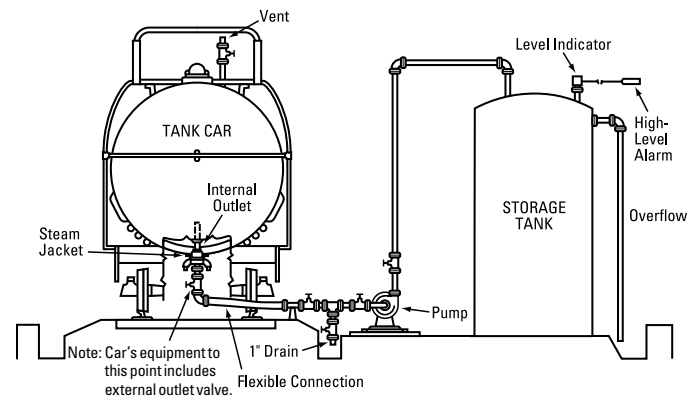
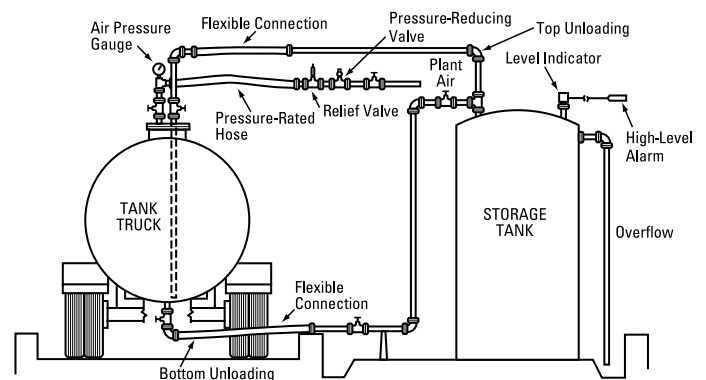


Figure 3: Unloading of Tank Truck by Air: Top and Bottom



Bulk liquid storage. Liquid calcium chloride may be stored in either open-top or closed tanks. Open-top tanks are usually associated with very large, outdoor vessels where dilution from precipitation and humid air exposure is either not an issue or is managed by mixing or reconcentrating the calcium chloride. Storage tanks that are closed with limited air exchange have the advantage of remaining uniform in concentration for long periods of time without additional mixing.

When periodic mixing is desired, it is usually accomplished by pumped recirculation or by mechanical agitation. Air sparging is sometimes used; however, it has the potential to affect product concentration by adding or removing water, and by creating calcium carbonate precipitate from the reaction between calcium chloride and carbon dioxide in the air.

Tank design should incorporate options that facilitate the cleaning of solids from the bottom of the tank. These solids may arise from several different sources:

1. Sodium chloride that precipitates as the liquid calcium chloride cools
2. Carbonate and sulfate found in dilution water that precipitates on contact with calcium
3. Carbonate that precipitates when calcium chloride reacts with carbon dioxide in air

The preferred material of construction for large, liquid-storage tanks is carbon steel with an epoxy-based interior lining and epoxy-based exterior paint. Common stainless steels should not be used for liquid calcium chloride storage because they are subject to chloride stress cracking, even at temperatures as low as 100°F (38°C). Nonmetallic materials, such as fiberglass or plastic, work well for smaller tanks at near ambient temperatures; however, the puncture resistance and structural strength of these materials, relative to carbon steel, should be evaluated.

Releasing the Empty Tank Truck or Tank Car for Return Transit

The following applies to releasing an insulated tank truck or tank car that has been bottom off-loaded with steam coils. The same principles apply to other situations – valves must be closed and manways secured before releasing a vehicle for return transit.

1. Close the internal bottom outlet valve.
2. Close the external bottom outlet valve, carefully disconnect the unloading line, and securely replace the bottom external outlet valve plug.
3. Disconnect the steam lines and blow out the heating coils with compressed air. Do not replace the caps on the inlet- and outlet-steam connections; let them hang by their chains.
4. If steam has been applied to the steam jacket of the bottom outlet leg, do not replace these caps after the steam line has been disconnected. Allow them to hang by their chains; otherwise the bottom outlet leg may freeze and crack.
5. After removing all connections, replace the closures on all other tank openings. Securely fasten the dome cover.

Summary

The safe handling and storage of calcium chloride products is more easily accomplished when the handler understands why calcium chloride requires distinct handling/storage procedures and how these procedures vary based on the specific situation.

When handling and storing calcium chloride, it is important to carefully read and follow these general guidelines. However, these guidelines are not to be considered a complete and comprehensive technical reference. Also consult product and application literature such as Material Safety Data Sheets, which include information on health and handling precautions, safety guidelines and product regulatory status.

For more information or to find an authorized distributor of
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