

Magnesium chloride vs. calcium chloride solutions

This article examines the comparative benefits of Magnesium chloride and calcium chloride solutions.

Calcium Chloride Conversion / Equivalency

Magnesium chloride and calcium chloride solutions cannot be compared at equivalent solution percentages due to the fact the materials have different molecular weights. Comparing the weights of the two compounds shows that calcium chloride (111) weighs 17% more than magnesium chloride (95). Therefore, if you have identical percentages by weight of the two solutions, then there is 17% more magnesium chloride in solution by volume than calcium chloride. The following table shows equivalent solutions by weight between magnesium chloride and calcium chloride.

Magnesium Chloride	Calcium Chloride
33.0%	38.5%
32.0%	37.3%
31.0%	36.1%
30.0%	35.0%

Note that molecular weight conversion has been universally adopted in most US States and forms the basis of equivalency in Alberta, British Columbia, Manitoba, Nova Scotia and Saskatchewan.

There is also a difference in the size of the molecules of the two chemicals. The Magnesium Chloride molecule is smaller. The dust control ability of each chemical is created by the bond between the negative ions of the water molecules and the positive ions of the metals (Mg & Ca). The bond keeps the water molecules in a liquid state and prevents evaporation at higher temperatures.

Both metal ions have the same charge, but with the Magnesium molecule being smaller, the charge is distributed across a smaller surface area, resulting in a stronger and denser electrical field. The stronger the electrical field, the tighter the bond between the Magnesium molecule and the attached water molecules.

The strength of this electrical field and the tighter bond it forms with water determines its ability to stay active as a liquid. As a dust suppressant, the water molecules bonded to either molecule will not evaporate and will maintain a moist condition.

Attached Water Molecules

Temperature (C)	Temperature (F)	Magnesium Chloride	Calcium Chloride
-4	25	8	6
0	32	6	6
30	86	6	4
44	111	6	2

Technically speaking, Magnesium chloride has the distinct advantage as it has more water molecules attached to it at all temperatures. Chloride compounds are noted to significantly increase the surface tension of water molecules between soil particles when used in soil stabilization and dust suppression. This property helps to slow evaporation and further increase the compacted density of the road as drying progresses.

Field Performance and Analysis

Magnesium chloride is "more effective than calcium chloride solutions for increasing surface tension, resulting in a very hard road surface."

Missouri Highway and Transportation Department; "Advice on Road Dust Suppressants." Technology Transfer Assistance Program, 1986.

In tests for the MX missile program, the Boeing Company found that hygroscopic materials did the best job as dust palliatives, and of this group, magnesium chloride was preferred.

Transportation Research Board National Research Council - Washington, D. C. 1991

The U.S. Army Corps of Engineers has tested magnesium chloride for use on assault airstrips and unsurfaced tank trails. "The MgCl₂ was selected for use at both installations because of its hygroscopic properties, which binds the fine solid particles (dust) to the larger soil particles by absorbing moisture from the air. The surface produced is a tight, macadam-like surface when compacted." They also state that "MgCl₂ is the most economically known product for controlling dust from tracked vehicles on cushionless (sand and gravel) soils."

Robert A. Hass; "Dustproofing Unsurfaced Areas: Facilities Technology Application Test (FTAT) Demonstration, FY85", U.S. Army Corps of Engineers, 1986. Technical Report GL-86-20. Available from NTIS

The U.S. Forest Service has found magnesium chloride to be an excellent road stabilization agent and dust suppressant. The results of dust treatment with magnesium chloride received high marks in all areas.

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