Why $CaCl_2$ for Roads

I. Dust Control and Stabilization of Unpaved Roads

A. History

1. Automobiles were introduced in Germany around 1890 which led to the formation of street departments. These departments were charged with the building of stone macadam roads to keep the autos out of the mud. Soon, the dust created from the stone became a problem. They were able to solve this problem with $CaCl_2$ because it is both hygroscopic and deliquescent (draws moisture and resists evaporation).

2. When Detroit started building automobiles in the early 1900s, Dow Chemical started separating $CaCl_2$ out of the brine stream at their plant in Midland, Michigan to serve the growing market for dust control.

3. In 1956, the U.S. Congress authorized construction of the Interstate Highway System. One caveat was that the state highway departments had to design and build the highways to a minimum standard of a twenty-year-life. To satisfy the twenty-year-standard, AASHO built a test track in Ottawa, Illinois to do destructive testing of various combinations of aggregate, asphalt, cement, and pozzolanic materials to measure the potential life of the roadway. As the test track was being built it was decided that they would measure the dust/aggregate loss of the unpaved test track. It was found that on an 18-foot-wide road, with 100 ADT (average daily traffic), 300 tons of aggregate would be lost per mile per year. It was then determined that if 2 pounds of flake $CaCl_2$ per square yard was applied and exposed to the 100 ADT the aggregate loss was only 30 tons per mile per year.

B. Example

1. As the results of the test track measurements became known, the $CaCl_2$ use by highway departments with unpaved roads grew. As an example, Ogle County, Illinois began treating 400

miles of their township roads in 1964. By 1974, they had concluded that their aggregate replacement need was only 1 inch of new aggregate every 10 years. This 400-mile-stretch averaged 100 ADT. Maintenance blading was reduced to only problem spots and then only as few as 1 or 2 times per year. Also, the strength gain and frost heave protection allowed their roads to not be posted with load limits during the Spring thaw.

II. Stabilization and Frost Heave Protection of Aggregate Base for Pavements

A. Testing the Choices

1. In 1978, the University of Tennessee Civil Engineering Department did a study of $CaCl_2$ treated aggregate versus aggregate with H_2O only on a section of I-24 North of Nashville. The $CaCl_2$ treated section achieved 120 to 140 PSI density with half as many passes of the roller as the H_20 only section. Due to the $CaCl_2$, its section did not “dry out” like the H_2O only section, and it did not have to be reworked to maintain its 95 PSI density. After measuring the strength difference, the $CaCl_2$ section was so strong that 1 inch of asphalt was reduced in the pavement (more than paying for the 0.6% $CaCl_2$ added to the aggregate). After both sections were paved, the $CaCl_2$ section was given a 25-year-life rating versus only 12 years for the H_2O only section.

B. Reclamation of Distressed and/or Failed Pavements and/or Building New Base for Paving

1. It is common for a highway department to have some of their paved roads fail. This failure may be due to increased traffic over the original design ADT, poor construction, base failure, drainage problems, etc., and this failure is inevitable. Reclamation is then called for and CaCl2 is the most cost-effective solution.

2. As an example, a Tennessee county bid for cement treated base (CTB) on an 8-mile project and paid $8.00 per square yard. Another county put together a project for $CaCl_2$ and a contracted reclaimer for $2.00 per square yard. In addition, while the CTB can be subject to “cracking” with the cracks reflecting up thru the covering pavement, that cannot happen with the

frost protection of the $CaCl_2$ base. Also, the $CaCl_2$ treatment can be handled by the highway department with their own personnel and a contracted reclaimer or their own equipment.

III. $CaCl_2$ and Aggregates

A. The Choice of Aggregate Used by a Highway Department is Influenced by Cost and Availability

1. Crushed angular particles can interlock and provide mechanical strength to carry traffic. The crushed particles of various sizes need moisture to lubricate the particles to slide together under compaction to achieve density. The Tennessee study showed that as little as 1.5 to 2.2 gallons of 32% $CaCl_2$ to increase the "lubricity" of the optimum H_2O content and achieve the greater density with ½ the compactify effort.

2. The ideal aggregate for an unpaved road wearing surface would be a "dense graded" with 100% passing the 1inch sieve, a uniform distribution of sizes (to minimize voids), and only about 4% minus 200 dust fraction to make the "cement" paste to bind it together when moisture is present. Of course, plain H_2O evaporates and results in lost aggregate as dust as opposed to $CaCl_2$ maintaining the optimum moisture.

3. The $CaCl_2$ is best combined with the aggregate in a pugmill but can also be blade mixed on the road or applied onto the surface at the road with an applicator truck.

IV. CaCl2 for Ice/Snow Control

A. NaCl (sodium chloride) is the Cheapest Melt Power Per Pound of Product, but it is Not Perfect.

1. NaCl is endothermic—meaning it has to have a heat source and free moisture to dissolve into a brine and perform. As ambient temps drop, and the free moisture becomes more solid the needed action is delayed. Tests show that it takes one hour for NaCl to cut thru ¼ inch thick ice at 25□ F.

a) An addition of 2% $CaCl_2$ by weight allows NaCl to work at 0□ F in an hour.

b) Even an addition of 1% $CaCl_2$ would speed up the process and ensure that your NaCl will be more cost effective.

c) Also, by prewetting the salt, bounce and scatter losses can be reduced from 30% to 2% as per Michigan DOT tests.

d) The delayed action of solid NaCl can be partially offset by applying an NaCl brine prior to the beginning of a storm at a rate of about 50 gallons per mile of a 23% brine. The H_2O fraction of the brine is expected to evaporate and leave salt particles on the road's surface. However, just as with solid NaCl, the brine residue is solid and can require one hour to re-dissolve with the advent of moisture before working.

  (1) The addition of a 5%, by volume, of 32% $CaCl_2$ to the brine will speed the action similarly to prewetting solid NaCl.

  (2) Plus, the CaCl2 blended brine is used to eliminate the possibility that the H_2O fraction will freeze before evaporating and users have found that they are able to spread the blended brine down to 10□ F.