Stabilization with Calcium Chloride

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It is a privilege for me to talk to you about some of the problems that face the County Engineer. My interest dates back to the time I spent as County Engineer of Knox County, Tennessee. The responsibilities that we faced then were undoubtedly the same as those you face today. The only difference might lie in the fact that today's increased volume and speed of traffic makes your responsibilities even greater.

Originally the traveling public wanted only a few loads of crushed stone or gravel in a mud-hole. Soon they realized this was inadequate. They demanded an all-weather surface to every extremity of the county. The county highway department satisfied this request in general, and then the housewife came into the picture by demanding an all-weather road that was dustfree. To her a dustfree all-weather road meant either bituminous or concrete surface. This led to a demand for hard-surfacing even on roads of little travel or importance.

Too often the public official yielded to this demand and placed a bituminous surface on a base of insufficient depth. The result is well known—a general breakup, many times during the first winter and thus, the highway department was faced with excessive maintenance expenses. Perhaps this has never happened in your county. If not, you are lucky and you should take every precaution against it.

One point should be remembered—"there is no such thing as a good cheaply-paved road." When properly constructed, pavement gives you the best and finest riding surfaces, but too often there is a tendency to economize on road base construction. Heavy maintenance costs have often been the direct result of this type of economy.

This thought brings us to the topic of our discussion today—"Stabilization with Calcium Chloride".

230
TYPES OF COUNTY ROADS

We do not offer a calcium chloride treated road as a substitute for a high type bituminous or concrete pavement. High type pavement has its place in the county system as well as the state primary system. And there are lower class roads of low traffic count in sparsely-settled areas that deserve only a small percentage of the maintenance funds available. But there are many miles of roads in the county system that, due to their traffic count and the number of roadside homes served, may be classed as an intermediate type road.

It is this intermediate type road that we are mainly interested in today. This is the class road that residents and motorists want improved—they usually ask that it be paved. Highway budgets may not permit the expenditures of several thousand dollars per mile for construction, so we must search for a way to answer these people and at the same time, stay within the budget.

One method of doing this is to maintain existing surfaces with calcium chloride. When properly applied it will give you a smooth-riding dustfree surface that actually sets the stage for future paving. Intermediate type roads in your county may be maintained in this manner for an indefinite period of years. At many locations, roads, so constructed and maintained, have adequately served the public for as long as 20 years.

PROPERTIES OF CALCIUM CHLORIDE

For those of you who may not be familiar with calcium chloride, let me say it is a product with many beneficial properties. For highway work, its main properties are:

1. It absorbs moisture.
2. It dissolves in this absorbed moisture.
3. It retains this moisture for long periods.
4. It lowers the freezing point of the moisture.

It is not difficult to determine why this product is beneficial in highway maintenance. You have seen unpaved roads that are stable under wet weather conditions, yet they become dusty and show signs of ravelling in dry weather; this weakness may eventually cause complete disintegration of the surface. If we can maintain moisture, similar to damp weather conditions, it is possible to hold the surface in a well-compacted state even during the hot summer months.
The water absorption and retention properties of calcium chloride aid in supplying a damp condition which will give you a smooth-riding dustfree surface without excessive floater material that is a definite hazard to safe driving.

Advantages of Calcium Chloride Consolidation

In the past 20 years numerous related research and field investigations have been conducted with the cooperation of nationally recognized organizations including the Highway Research Board, American Road Builders’ Association, and the Bureau of Public Roads. Similar studies have been made by universities, state and county highway departments, and other technical groups including the Calcium Chloride Institute.

This continuing work has proved certain important advantages from using calcium chloride either as (1) surface applications, or as (2) integral mix, or by combining both methods in the consolidation of granular wearing surfaces.

The advantages of calcium chloride usage most important to you as county highway supervisors and commissioners are that it:

1. Conserves road materials.
2. Reduces blading costs.
3. Provides smooth-riding dustfree surface.
4. Minimizes frost damage.
5. Adapts itself to stage construction.

Because the calcium chloride aids in conserving the aggregate placed on the road, usually it will not be necessary to add replacement material for years, once the road surface has been consolidated. Results of a study completed in 1951 in Onondaga County, New York, were presented by E. M. Baylard, Superintendent of Highways, at the 1952 Highway Research Board meeting. This gravel-loss study covered a 16-year performance of calcium chloride consolidated roads and it showed that the average loss of gravel per year was only 23.5 cubic yards per mile.

Because moisture is maintained in the road surface even during the hot dry summer months, little ravelling or deterioration takes place. Bladings normally can be reduced to 3 or 4 times a year. Mr. Baylard, in the paper previously mentioned, estimated that they saved 25 bladings per year. With the high rental cost of equipment and the present scarcity of manpower, this is an important feature to any highway engineer.
Officials say maintenance of a dust-free road surface is most important from the public viewpoint. The motorist and the housewife are usually satisfied without a bituminous pavement if they can be assured of freedom from dust and excessive floater material.

Research and field tests have conclusively shown that comparatively small percentages of calcium chloride are effective in reducing detrimental frost action which may result in need for complete replacement of road surfaces. Much of this research has been conducted right here at Purdue University.

To more adequately serve the traveling public, engineers are inclined to recommend building most rural roads in stages. The stages normally consist of (1) grade and drain, (2) light surfacing of aggregate, (3) stabilized aggregate wearing surface, and (4) bituminous or concrete pavement. Since years may elapse between certain stages, it is important to maintain improvements in each stage, to conserve road materials, and to build roads so future improvements may be made with least effort and expense.

With calcium chloride, a well-graded wearing course of several inches depth may be consolidated and maintained for years as a dust-free smooth-riding surface. It will be ready for improvement to higher type surface when plans call for such improvement. By following this procedure, many more miles may be improved by constructing a 3 to 4 inch depth calcium chloride wearing surface rather than the 8 to 10 inch depth base normally required for bituminous paving.

Economics

Calcium Chloride used in consolidation work means fewer bladings and a saving in materials. The economy of consolidation is largely dependent on the availability and cost of replacement aggregate and the number and cost of yearly bladings. Engineers often report that with calcium chloride consolidation, it costs less to maintain their roads. Mr. Baylard, in New York, estimated they save $65 per mile per year by using calcium chloride. J. T. Sharpensteen, County Engineer of Genessee County, Michigan, maintains all his 1,050 miles of gravel roads with calcium chloride. At the American Road Builders’ Association meeting in 1952, he reported the use of calcium chloride saves his county about $171,000 per year, or an average of $163 per mile per year on roads that carry from 25 to 3,500 vpd.

Many similar examples could be cited, but it is suggested that the best method of determining the feasibility of its use in a county
is to set up a few projects and keep accurate cost records on these projects.

**Materials**

Aside from providing a smooth-riding dustfree surface, calcium chloride fits well into county work. It is adaptable to a wide variety of local materials. The majority of local materials in Indiana meet specifications for consolidation. Where materials do not meet specifications, the addition of small amounts of either fine or coarse aggregate is normally the only material required. Experience proves that certain materials which fall outside the specifications are suitable under local conditions.

**Construction**

Construction and maintenance of calcium chloride treated roads are really simple operations. The Technical Service Engineers of the calcium chloride industry will assist you when you plan to try it especially if you are not familiar with its use. This service will probably be needed only on your first projects or in case of unusual conditions, since county maintenance crews can do an excellent job after they have used it on a project or two.

In selecting and constructing a project, there are several points that you might want to keep in mind.

1. **Materials**—Surface consolidation or stabilization should not be attempted under normal conditions unless there is sufficient metal to provide a 3 or 4 inch thick compacted mat. If this material is non-existent, or if it is not of compactable gradation, more aggregate or fines of proper gradation should be added. Generally the existing aggregates lack enough binder for adequate compaction. Often this condition can be corrected by blading binder soil from shoulders of the roadway and mixing it with existing metal. Many of the roads in this state contain properly graded aggregates, and consolidation should be accomplished with very little extra work.

   Please note that consolidation does not require the technical testing that stabilization does, it can be accomplished satisfactorily by rule-of-thumb methods.

2. **Proper crown**—It is absolutely necessary that the road has an adequate crown so water runs off the surface. A minimum crown of one-half inch per foot is required. The crown should be the inverted "V", and not the parabolic type. This will insure rapid runoff of water, even in the center of the roadway. Potholes develop where water is held on the surface.
3. *Adequate moisture*—There should be some moisture in the road before application of calcium chloride. The best procedure is to make the initial application early in the spring before moisture held there during the winter months has an opportunity to evaporate. Otherwise, the treatment must either be made directly after a rain or after the surface has been sprinkled.

4. *Application of calcium chloride*—Calcium chloride may be used either as a surface application or mixed integrally. In consolidation work the usual procedure is to make the application as a surface treatment after the material has been brought to the proper gradation and crown. Any type of drill, spinner, blower, or positive displacement type spreader capable of giving a uniform spread will give adequate results. All roughness must be bladed out of the road surface and the road metal should contain adequate moisture before calcium chloride is applied.

During the hot dry summer months, and when new material is added to a road before consolidation, it is often advisable to add calcium chloride integrally for the initial treatment, then mix it and water with the aggregate. Calcium chloride resists evaporation and permits retention of moisture during the compaction period.

Normal application of calcium chloride for initial treatment is one pound per square yard when used as a surface treatment, and one-half pound per square yard per inch of compacted thickness when mixed integrally. It is advisable to make a one-half pound per square yard surface application when the integral mix method is used.

Subsequent treatments of one-half pound per square yard should be applied as required during the summer. Unless unusually heavy traffic is encountered, two of these one-half pound treatments are adequate. Two pounds per square yard is the normal annual requirement. However, many roads have been maintained with one and one-half pounds per square yard. Compaction may be obtained either by the use of rollers or by traffic.

*Maintenance*

With a calcium chloride consolidated road, very little maintenance, other than periodic surface treatment, is required. Bladings are normally held to a maximum of four a year and it should not be necessary to add replacement material for many years.

*It is important both for economy and for preservation of the bond of the stabilized wearing course, that blading is done only if the road surface needs it.*
Typical annual maintenance might be outlined as follows:

1. *Early spring*—Shaping of road with patrol grader to adequate crown and smoothness and then application of one pound per square yard surface treatment.

2. *Summer*—Normally no blading is required; however, if roughness occurs, the blading should be done immediately following a rain. Blade only a road section of such length that will be readily compacted before the surface becomes too dry to bond under traffic.

Applications of one-half pound per square yard should be applied as needed. These applications should be made just before ravelling or dusting appears. Normally two applications per year are necessary.

3. *Fall and Winter*—Two to three bladings are usually required to keep the road in proper shape during winter months.

The Calcium Chloride Institute booklet “Maintenance Tips for Unpaved Roads” lists in detail the proper maintenance procedures and it is recommended for your use. Copies are available on request.

**Dense-Graded Granular Base Courses**

Calcium chloride has been used for many years as an admixture in the mechanical stabilization of dense-graded bases for both bituminous and concrete pavements. Although closely allied to consolidation, it is another subject, and time does not permit a thorough discussion today. However, we believe it advisable to mention the advantages derived from its use.

1. Increased density.
2. Less compactive effort required.
3. Better control of moisture during and after compaction.
4. Permits reduction in binder.
5. Controlled curing for increased stability.
6. Uniformity of surface.
7. Adaptable to stage construction.
8. Dustfree surface.
10. Provides frost protection.

The cost of the calcium chloride frequently adds nothing to the cost of the completed base because of savings in

1. The use of less water.
2. Need for less rolling.
3. Reduction in maintenance work between completion of the base and later priming with bituminous materials.
A new manual listing Properties and Design, Construction Procedure, and Specifications will soon be published. If you are interested in the use of calcium chloride in base construction, this manual, entitled “SM-1”, is available on request to:

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