Use of Calcium Chloride for Soils Base Stabilization in Maryland

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● THE STATE Roads Commission of Maryland has been privileged to cooperate with the Highway Research Board's Committee on Soils-Calcium Chloride Roads in certain field investigations that will provide a better understanding of the effect of calcium chloride in soil base stabilization. Although the chemical has been used quite extensively in the Maryland State Roads Commission's highway construction and maintenance program for many years, it is felt that research will assure obtaining maximum benefits when using this material.

The first test project, approximately 800 ft in length on State Route 2, consisted of stabilizing a granular base course 24 ft wide. Calcium chloride was applied to six test sections at rates of $\frac{1}{2}$, 1 and $1\frac{1}{2}$ lb per sq yd per 4-in. compacted course. Eight untreated control sections were alternated in the test area. The project was opened to traffic in October 1957 and cured for a month prior to double sealing the base with cutback asphalt and stone chips.

Physical sampling of the in-place road materials has been held to an absolute minimum so as not to destroy test points. After sufficient data are collected by nondestructive tests certain areas will be sampled for physical analysis. Selection of these test points will most likely be on the basis of other tests and observed performance.

Evaluating the effectiveness of the stabilization was accomplished primarily by visual observation and use of deflection profiles. The Benkelman beam with Helmer recorder attached is proving to be a most valuable instrument with which to follow changes having to do with temperature, time, or other conditions.

A study of many deflection profiles has indicated that of the several measurements that can be obtained from each profile, usually only one or two of the measurements are needed to arrive at a conclusion.

By studying these profiles throughout the base construction period it was possible to identify a number of conditions of stability or instability from the general shape of the profile. This knowledge was found valuable in evaluating damage to the soil base as a result of cold weather, and later evaluating its recovery from frost action.

A visual inspection of the project in January 1958, during an early thaw following a period of cold weather, showed no signs of distress (Figs. 1, 2, 3). However, it was noted that in the untreated sections a cushion effect, or resiliency, was felt underfoot. In the latter part of February, following a similar period of cold weather, visual inspection indicated extensive damage in the form of alligator cracking in the untreated sections (Fig. 4).

The treated sections were found to be free of cracks and showed no failure. The spongy texture was again felt underfoot in the untreated sections. At the time of this inspection it was possible to obtain a series of deflection profiles of the several test sections. These pro-

Figure 1. Route 2 test section after first spring thaw.

Figure 2. Limited distress area in Route 2 after first spring thaw.

Figure 3. Distressed area in untreated section of Route 2 after second thaw period.

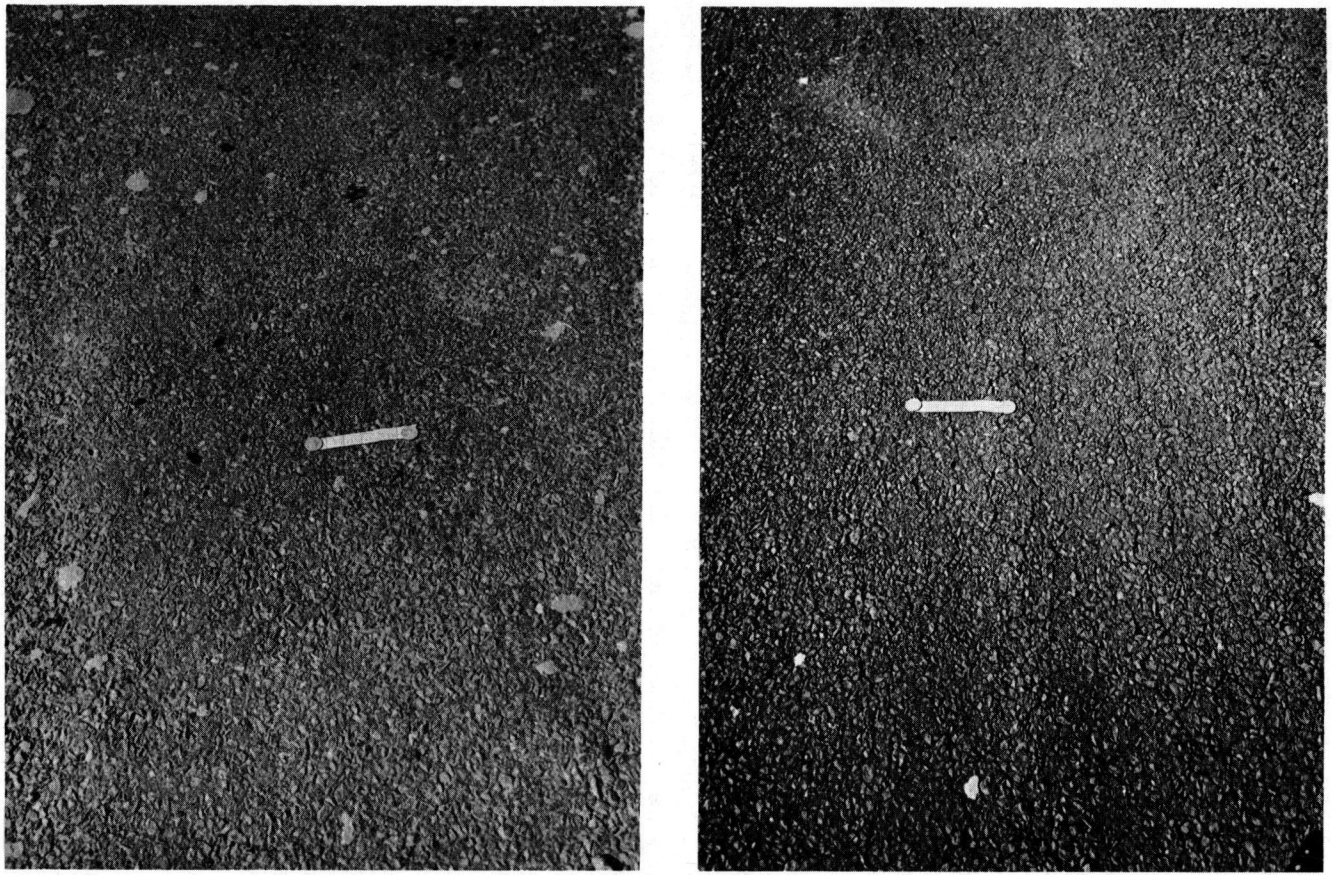

Figure 4. Comparison of calcium chloride treated section (left) and untreated section (right), showing alligator cracking in untreated section, Route 2.

files indicated a definite loss of stability in the same sections where distress was recognized by visual observation.

On this same project, although not considered a part of the experimental section, an opportunity was presented to use calcium chloride only as a dust palliative and to prevent loss of fines before the base could be sealed. Excellent resistance to frost action was visually apparent in this surface-treated area.

About 6 weeks later the project was again inspected and another set of deflection profiles was obtained. The profiles indicated that almost complete recovery from frost action had taken place. The double seal at this time did not show any significant increase in alligatoring. It therefore appears that considerable damage resulted from the first period of cold weather.

The latest set of deflection profiles, obtained early in October 1958, indicated a complete recovery from the frost action.

In May 1958 construction started on Route 33 on an 8-in. compacted soil-flyash-lime stabilized base course. This project presented an opportunity to initiate a research project to evaluate the effect of the addition of calcium chloride to the stabilization mixture.

Research and experiences of the past indicate that comparatively small quantities of calcium chloride (less than 1 percent) added to natural soils facilitate compaction. Likewise, addition of the chemical to portland cement concrete in which flyash has been used has indicated an improvement in the end product. A previous report (1) indicates that a mixture of lime-flyash-slag-1 percent calcium chloride resulted in greater strengths than were obtained without the additive. Because of the foregoing results, it was believed that the proposed test project would provide positive information.

Approximately $\frac{1}{2}$ percent of calcium chloride by weight was added to the mixture at the central plant to provide for a test section 100 ft long, of 12-ft wide base.

It was noted during construction that although excellent compaction was obtained elsewhere on the project, less compactive effort was necessary in the test area to attain equal density. In fact, it was apparent to the contractor after the first loads that a greater loose thickness had to be used to maintain the compacted grade of the adjoining untreated area. Another feature was in the shaping operations during the fine grading after seven days. The small percentage of aggregate in the natural sand purposely specified to aid in securing a uniform mix normally disrupted the surface in front of the shaping blade. In the test section, however, the pasty consistency of the mixture resulted in a clean shaping operation without surface distortion.

Deflection profiles (Fig. 5) were obtained 14 days, 30 days and 90 days after placing. The deflection profiles indicated that near ultimate strengths were obtained at the 14 days or less in the test area containing calcium chloride. The profiles indicated a markedly accelerated consolidation action (probably pozzolanic) where calcium chloride was used.

During the middle of November 1958, at which time the experimental section was three months old, 1-ft square blocks of the stabilized base were sawed from the road for laboratory testing. Compressive strengths

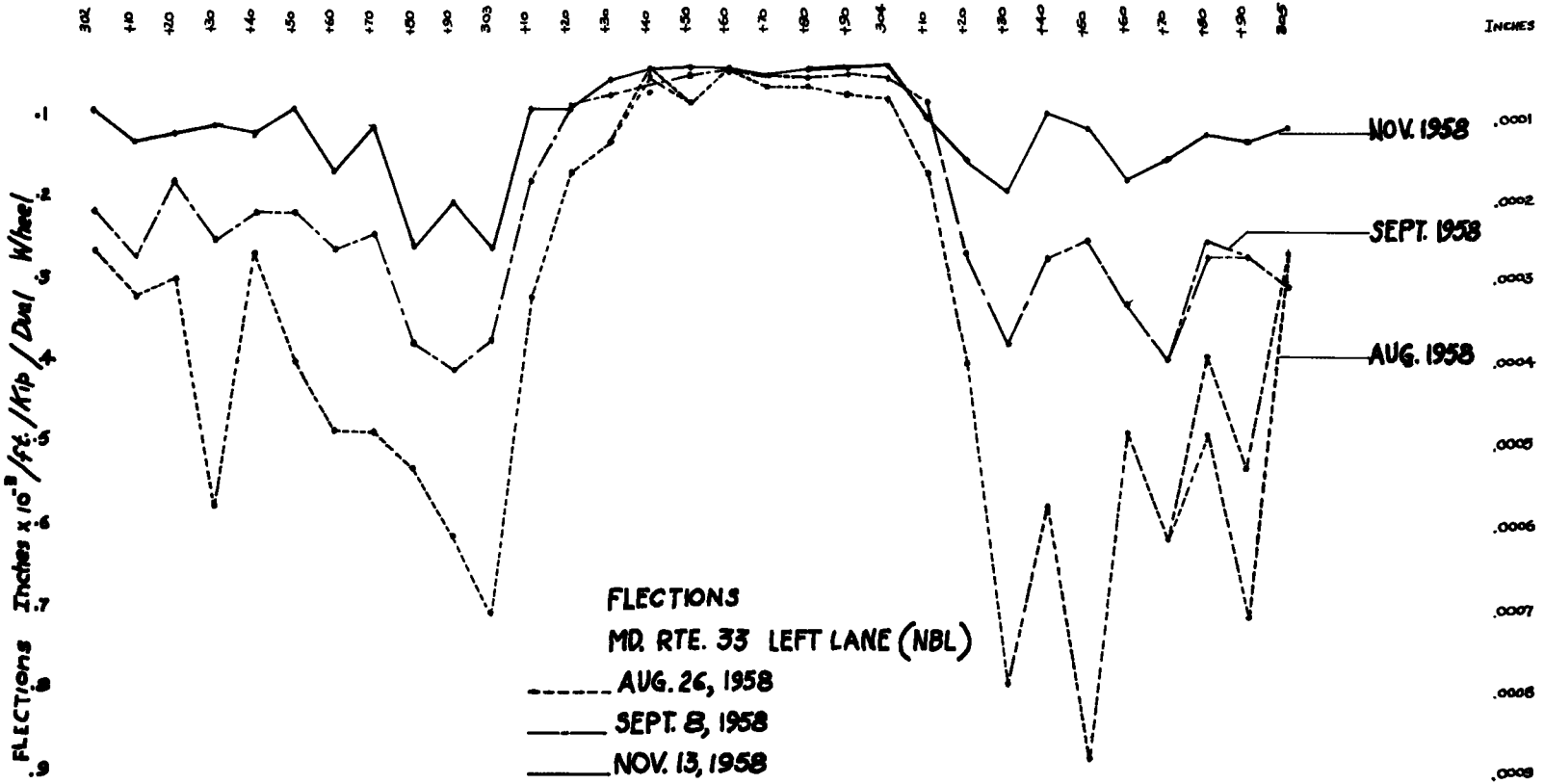

Figure 5. Graph indicating deflections on Maryland Route 33. Comparison of calcium chloride test section and untreated section.

(over 800 psi) were one-third greater on specimens from the calcium chloride test section than at other locations.

Experience in evaluating these two projects suggests that there is a definite value in the use of the Benkelman beam with Helmer recorder to obtain information from a recorded deflection profile. This is a worthwhile nondestructive method for evaluating load-carrying characteristics of a road.

The performance of these projects will be followed and tests that might help in a further evaluation will be performed.

It is hoped that the limited experience with calcium chloride in soil bases will interest other organizations in developing more extensive research.

REFERENCE

1. Minnick, L. J., and Miller, R. H., "Lime-Flyash-Soil Compositions in Highways." HRB Proc., 31:511 (1952).