Subbase Treatment  
Using  
EMC$^2$ Soil Stabilizer

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### Abstract

The experimental feature test site described in this report was completed in 1996 as part of the Alaska Highway MP 1222-North construction project. It consisted of a road section (1985-ft long) where a proprietary organic stabilizing agent, EMC², was used to stabilize the subbase layer. This test section was adjacent to a normally constructed control section (3295-ft long). Except for rotomilling EMC² into the top of subbase, workers constructed the test and control sections using the same methods and materials.

In spring 1997, visual inspection of the research site showed like-new condition, except for one thermal crack. According to the FWD deflection data taken in spring 1997, the EMC² section appeared to be a problem. The control section appeared to exhibit about 2.2 times the service life potential of the EMC² section. The EMC² seems to have softened the subbase layer.

In the summer of 2001, backcalculation of moduli using FWD deflection data revealed that the unstabilized subbase in the control section is about 30% stiffer than the EMC² stabilized subbase.

Therefore, it was found that the use of this particular additive in the subbase did not improve the structural performance of this experimental roadway section (covered with an asphalt surface treatment in the form of a high float surfacing). It might also be possible that the control section contains undisturbed sublayers of asphalt concrete, which could act as subgrade reinforcement, actually strengthening the section.
SUBBASE TREATMENT USING EMC\textsuperscript{2}™ SOIL STABILIZER

ALASKA DOT&PF RESEARCH PROJECT 97-15
TITLED:

“STABILIZED BASE UNDER ASPHALT SURFACE”
ON
ALASKA HIGHWAY, MP 1222 - NORTH

BRF-I-IM-0A1-1(9)/65748

Research and Technology Transfer
Alaska Department of Transportation & Public Facilities

October 2002
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1- Introduction

1-1 Problem Statement

Prior to rehabilitation, severe fatigue cracking, rutting, and heavy patching were observed within many sections of this project. Much of this damage resulted from the presence of excess fines in the pavement structure, even though traffic levels were low. Ideally, aggregate materials within a pavement structural section (asphalt concrete layer plus upper 42 inches (3.5 ft) of embankment fill) contain a small fraction of silt and/or clay size particles. This -#200 sieve-size fraction is referred to as “fines.” Limitations on the allowable percent of fines within the pavement structural section are prescribed by the Alaska Department of Transportation & Public Facilities (ADOT&PF) pavement design method (*Excess Fines Method*), given a predicted number of Equivalent Single Axle Loadings (ESALs) over a selected pavement design life. The design ESAL is a way of defining the total number of standardized vehicle loadings that the pavement structure must withstand. In terms of alligator cracking (fatigue) and permanent deformation (rutting), pavement performance is particularly sensitive to excess fines in the upper foot or so of the base or subbase materials. The higher the design ESAL, the more sensitive the pavement structure is. Aggregates within the upper foot of the existing pavement structure averaged more than 15 percent fines. Normal design requirements would have limited the fines content to a range of perhaps 6 to 10 percent.

The project’s design was constrained by the budget limitations of FHWA “3-R”-type funding. Therefore, it was necessary to bring the substandard pavement structure back to line and grade using little more than existing materials. As noted in the project’s pavement design study, "clean, durable aggregate is a precious and expensive commodity in this area." It was considered economically impracticable to “sweeten” the existing pavement structure by adding large quantities of better materials. The pavement design aimed at a modest structural improvement by adding a new, 4-inch-thick base course layer, stabilized with asphalt emulsion. Final paving consisted of an emulsified-asphalt surface treatment for that portion of the construction project discussed in this report.

It was thought that a better pavement structure might be economically achieved by stabilizing an additional foot of material, under the stabilized base, with a low-cost chemical additive.

1-2 Objective/Scope of Research

This study was initiated to determine if the structural performance of a paved roadway could be significantly improved (relative to a nearby control section) by treating a 1-foot thickness of subbase with a low-cost, soil-stabilizing additive. A test section of roadway incorporating a stabilized subbase was constructed next to a normally-constructed control section. Except for the addition of a soil stabilizing chemical to the subbase, the test and control sections were constructed using the same methods and materials.

Both the test and the control sections (together defined as the research project site) were scheduled to be monitored for 4 years, starting in 1997. Monitoring called for: 1) visually assessing the performance of the pavement, and 2) the collection of deflection data.
Deflection data was analyzed to determine the structural capacity of the pavement structure in terms of Equivalent Single Axle Loads (ESALs) to failure.

Comparisons were made between the test and control sections. Initial comparative work was described in a 1997 interim report by Bob McHattie, P.E., ADOT&PF Geotechnical Engineer (“Subbase treatment using EMC2 soil stabilizer - Alaska Highway, MP 1222–North”, Research Project 97-15, Geotechnical Report, Oct.1997). The majority of that report is reproduced in this final report.

2- The EMC² Soil Stabilizer

EMC Squared (EMC²), a product of Soil Stabilization Company, Inc. (SSC). Both “EMC Squared” and “EMC²” are trademarks of Soil Stabilization Products Company, Inc., P.O. Box 2779, Merced, California 95344. EMC² (Earth Materials Catalyst) is a proprietary, organic chemical, previously known to the ADOT&PF through the SSC literature, and from trial use, as a gravel-surfacing stabilizer, on an unpaved section of the Elliott Highway near Fairbanks. According to a company brochure, EMC² is a "biocatalyst formulation designed to economically improve the cementation and stability of compacted aggregate and earth materials." The specific chemical composition of EMC² is not disclosed by SSC although it is advertised as a slightly basic liquid, soluble in water, containing no detergents or organic solvents. SSC claims that the material is non-corrosive and biologically non-hazardous. Contract specifications required:

“The stabilizer shall be safe for handling without the use of protective breathing apparatus or protective clothing. A standard Material Safety Data Sheet shall be furnished by the manufacturer. The manufacturer shall also provide documentation certifying that there are no detectable organic solvents or identifiable EPA 8270 target compounds in the stabilizer, based on U.S. EPA 7000 Series (TTLC or CAM17) for metals and Method 8270. The materials supplier shall provide the Engineer with a certification of compliance with these requirements when the EMC² is delivered to the project site.”

According to SSC, the stabilizer: 1) facilitates compaction of the aggregate, thereby promoting maximum possible densification, and 2) serves as a cementing agent. It was expected that the structural capacity of the treated aggregate layer would be increased while permeability and moisture susceptibility would decrease. It was thought that treated aggregate would exhibit a reduced susceptibility to freeze-thaw effects, thus reducing the associated problem of springtime thaw weakening.

3- Location & Site Description

The construction project is located on the Alaska Highway between Milepost 1222 and 1270. Milepost 1222 is at the Canada-Alaska border. This is, generally, an area of muskeg valley bottoms and low rolling hills, with foundation conditions ranging from ice-rich permafrost swamps to rock cuts. Within the project limits, especially within the first 8 miles of the project (Mile 1222 - 1230), roadway performance has been affected by a combination of thawing, ice-rich permafrost foundation soils and poor-quality fill materials. This section of roadway was previously reconstructed during the period 1965-1967 by Green Construction Co., as part of the Alaska Highway, Mile 1235 - Canadian Border project. Stationing defined for the 65-67 project was also used on the latest rehabilitation project (and in this report).
Abutting EMC²-treated and control sections were selected from a uniformly continuous portion of sidehill roadway alignment, with uniform southern exposure to sunlight, and with a fairly constant centerline grade of about 3% downward toward the east. This selection emphasized uniformity of terrain, damage type, and damage severity. Both of these sections (a total length of about 1 mile) comprise the entire length of the research project site. This particular mile-long stretch of highway exhibited a relative minimum of foundation-related, i.e., thaw-related damage, but was severely damaged due to pavement structural failure. The EMC² test section is 1,985 long and located between Station 392+00 and Station 4602+00 (approx. mile 1,226.9 to 1,226.5). The control section is 3,295 feet long and located between Station 4602+00 and Station 4634+95 (approx. mile 1,226.5 to 1,225.9). There was no particular reason for selecting a control section longer than the EMC² section, except that the consistency of the terrain allowed for the additional control section length. (It is to be noted that because of large station equation adjustments along the alignment, true lengths cannot be calculated directly by subtracting beginning from ending stations).

4- Design & Construction of the Research Project Site

MB Construction Company constructed the project segment containing the research project during June-July of 1996. David Schaefer, ADOT&PF Construction Resident Engineer, administrated the contract on behalf of the Department.

For the EMC² test section, the design required treatment of the upper, foot-thick portion of the existing pavement structural section with EMC². The existing material was reprocessed with a diluted solution containing EMC² additive at a rate of 1 gallon (EMC² concentrate) per 13 cubic yards of aggregate. Upon compaction, this formed a subbase for the new base course and pavement surface. Four inches of new asphalt-stabilized base course material, and a high float emulsion surface treatment surfacing were placed over the stabilized subbase. The stabilized base was a mixture of standard minus 3/4 inch crushed aggregate base course material, crushed asphalt pavement (the original pavement), with a 3% (by total weight) addition of CSS-1 asphalt emulsion. The surface treatment was constructed using HFMS-2s high float emulsion and a cover coat of dense-graded minus 3/4 inch aggregate.

The control section was constructed normally, by placing the stabilized base course, then a high float surface treatment over a re-graded but unstabilized subbase.

The EMC²-stabilized subbase was constructed under contract special provision section 302, “Processing for Subgrade Modification,” and special provision section 727, “Soil Stabilization Material.” These specifications, fully describing the EMC² stabilization construction process and materials requirements, are attached to this report as the Appendix.

The cost of obtaining and placing EMC² was included in Pay Item 302(3); the unit of payment was per station. The awarded bid price for Pay Item 302(3) was $1,500 per station (1996 dollars). Given the 1-foot stabilization thickness by 36 foot width, the cost of subgrade modification was almost $0.42 per square foot of roadway surface -- or about $11.25 per cubic yard of subgrade modification -- for the EMC² soil stabilizer plus processing.

In a report dated Jan. 6, 1997, Mr. Schaefer described activities and problems associated with constructing the EMC² test section. Early on, during the process of mixing EMC² into the required 12 inch thickness of existing material, it was discovered that that layer contained one or
two additional layers of old asphalt concrete. The presence of the old pavement materials caused mixing problems, and according to Schaefer: “The soil/asphalt matrix consisted of EMC\textsuperscript{2}, mud and asphalt chunks.” Mr. Schaefer reported that the mixture was “obviously” above optimum moisture for acceptable compaction, and was unworkable. This problem was resolved by a decision to Rotomill the material to a depth of 12 inches, thus breaking up the larger asphalt concrete slabs and chunks into pieces smaller than about 2 inches. The material was then aerated by blading (to reduce moisture), and compacted. Because of the unusual nature of the material, acceptable compaction was achieved through use of a control strip. Roller passes within the control strip were repeated until the increase in density attenuated. That number of passes was defined as an acceptable compaction effort for the remainder of the test section. Mr. Schaefer noted that Glenn Gates, a representative of SSC, visited the construction site during placement of the EMC\textsuperscript{2} material. Mr. Schaefer stated: “This (construction) procedure took a couple of days, but the result was acceptable to the factory rep. (Mr. Gates).”

5- Monitoring

The initial plan for this experimental features study called for ADOT&PF personnel monitoring both the stabilizer-treated (test) section and the control section, annually, for a period of 4 years. However, monitoring was done in 1997 and 2001 only. The first monitoring began in late April of 1997. It included a visual (subjective) assessment of rutting, cracking, and patching, and involved collecting FWD deflection data, with the aim of performing an objective evaluation of the pavement’s structural capacity. The second monitoring, in summer of 2001, consisted only of FWD deflection data collection. This monitoring was the sole basis for determining the economic viability of the experimental treatment.

The initial plan also called for documenting the general performance of the experimental and control sections, with the aid of photos during the spring of each year. Emphasis was placed on describing of cracking, rutting and maintenance patching. Care should have been taken to differentiate between pavement damage caused by failure of the pavement structure and damage associated with foundation failure.

Deflection data was collected during the spring and fall of 1997 and summer of 2001, using a Dynatest Model 8000 Falling Weight Deflectometer (FWD). Standard FWD test methods were used; the deflection basin caused by a 9,000 pound impact loading was measured by a series of 7 geophones. This test setup is a standard one used by DOT&PF for pavement design work, and simulates the load imposed by a standard design axle, i.e., an ESAL. During the spring of 1997, data was collected weekly for a period of six weeks, from a series of test points spaced at 0.05 mile intervals. A single set of fall data (Sept.1997) was collected at the same data points.

6- Analytical Methods

For each set of FWD deflection data, estimations of structural service life (in terms of ESALs-to-failure) were calculated using the Dynatest Inc. "ELMOD" (version 3.2e) computer program. In computer computations, one ESAL application represents the engineering standard of one actual load repetition of a single, dual-wheeled axle, loaded to 18,000 pounds. By assessing the ESALs-to-failure, the overall ability of the pavement structure to carry traffic is quantified for the treated versus control section.
For these analyses, the ELMOD program was configured to predict the total number of ESALs before onset of two failure types: 1) fatigue failure (alligator cracking) of the asphalt pavement surfacing, which is associated with tensile strain at the bottom of the pavement surfacing layer, and 2) functional failure (rutting/roughness) associated with vertical stress at the top of each material layer located beneath the pavement surfacing.

The program was also configured so that service life estimates, from each set of deflection data, were calculated based on holding backcalculated elastic modulus values constant for each layer of material below the pavement surfacing. In other words, modulus values were held constant during the service life computation as if “locked” from the date of deflection testing to the end of the service life. This simplification provided a handy way for directly comparing the relative “robustness” of different pavement structures based on single sets of deflection data collected on a given date -- an expedient way to directly compare the structural capability of the two sections at any one point in time.

Seasonal variations in the pavement structure’s are accounted for by repeating the service life comparisons, using deflection data collected during different seasons. As mentioned previously, 6 sets of deflection data were collected during the spring of 1997, and 1 set in the fall of 1997.

Repeating the analysis on deflection data collected during spring and fall seasons addresses the question of whether ESAL projections are cyclically affected by variations in temperature and moisture of materials. Repeating the analyses for several years addresses the question of whether ESAL projections are affected by repeated freeze/thaw cycles or other materials changes which occur over time.

It should be mentioned that the above analysis (estimation of pavement life) was done for the data collected in 1997 only. For the summer of 2001 data, only backcalculated moduli values were obtained for the different pavement layers in both the treated (test) and control sections.

7- Performance Evaluation Based on 1st Year’s Observations (1997)

A visual examination of the research project site was done on April 23, 1997. Deflection data was collected at 0.05-mile intervals on: April 23, 30, and May 5, 14, 21, 28, and September 17, 1997.

7-1 Surface Condition

The condition of the roadway surface of the test section and the control section on 4/23/97 was as-built, i.e., like new. Not even a single thermal crack was visible at that time.

7-2 Deflection Analysis

Figures 1 and 2 show spring and fall estimates of ESAL service life, respectively. In both figures, it is obvious that the control section’s pavement structure is better than in the EMC2 section. Figure 3 “filters” the data scatter shown in Figures 1 and 2 by averaging the service life estimates for each date; this further simplifies interpretation of the data. For each deflection testing date shown on Figure 3, the average service life of the control section is significantly above that of the EMC2 test section.
The shapes of the curves in Figure 3 are interesting. The control section curve has the expected form, showing strength loss beginning in early springtime, and ultimate recovery by fall. The curve representing the EMC\textsuperscript{2} test section indicates that a low-strength condition has already developed by the time of the first deflection test (4/23/97), a condition which persists throughout the spring. Both sections exhibit considerable strength increases by the time of the 9/17/97 deflection readings, although the EMC\textsuperscript{2} section never achieves more than about half the fall strength of the control section.

Figure 4 was derived from Figure 3 by dividing the estimated control section service life, for each deflection date, by the EMC\textsuperscript{2} section service life. Showing ratios between about 1.5 and nearly 3.5, Figure 4 directly addresses the main research question concerning relative strength. The average of ratios shown in Figure 4 is 2.2, i.e., the control section appears to exhibit about 2.2 times the service life potential of the EMC\textsuperscript{2} section.

7-3 Discussion of the 1st year’s Evaluation

At first cut, there appears to be a problem with the EMC\textsuperscript{2} section, at least according to the deflection data analysis. On the other hand, the April 1997 appearance of both sections was excellent. It is probably much too early to tell if the substantial structural differences between the test and control sections translate into visually-observable performance differences. For now though, the prognosis for the EMC\textsuperscript{2} section is for relatively early failure.

Why is there an apparent, significant difference in structural competency between test and control sections? The presence of EMC\textsuperscript{2} may have actually softened the subbase structure. Other factors could be operative however. For example, it is possible that the control section contains undisturbed sublayers of asphalt concrete (like the old pavement layers discovered in the EMC\textsuperscript{2} section) which could be acting as subgrade reinforcement -- actually strengthening the control section. Additional drilling would be necessary to investigate this particular possibility. It is also possible that evaluations conducted in the coming years may change the tentative, negative impression of EMC\textsuperscript{2} as a base course additive.

8- Evaluation Based on 5th Year’s Deflection Testing (2001)

The evaluation of summer 2001 consisted solely of deflection testing of the treated and control sections. No visual assessment of the sections was performed. Deflection testing was done as part of the ADOT&PF Statewide Pavement Management data gathering effort on the state NHS roadways. As in 1997, the ELMOD program was used to backcalculate pavement layer moduli. Scott Gartin, P.E., ADOT&PF Pavement Management Engineer provided the following moduli estimates:

<table>
<thead>
<tr>
<th>Backcalculated Modulus, ksi</th>
<th>Control section</th>
<th>EMC\textsuperscript{2}-treated section</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.75&quot; top layer*</td>
<td>61</td>
<td>141</td>
</tr>
<tr>
<td>12&quot; Subbase</td>
<td>58</td>
<td>45</td>
</tr>
<tr>
<td>Subgrade</td>
<td>14</td>
<td>21</td>
</tr>
</tbody>
</table>

* : 0.75" high-float surfacing + 4" emulsion-asphalt treated base
From the above results, it is seen that the subbase layer in the control section is about 30% stiffer than that in the EMC²-treated section. Therefore the presence of EMC² may have actually softened the subbase structure. Other factors may have contributed to this too. For example, it is possible that the control section contains undisturbed sublayers of asphalt concrete (like the old pavement layers discovered in the EMC² section) which could be acting as subgrade reinforcement -- actually strengthening the control section.

9- Summary and Conclusions

The experimental feature test site described in this report was completed in 1996 as part of the Alaska Highway MP1222-North construction project. It consisted of a road section (1985-ft long) where a proprietary organic stabilizing agent, EMC², was used to stabilize the subbase layer. This test section was adjacent to a normally constructed control section (3295-ft long). Except for rotomilling EMC² into the top of subbase, workers constructed the test and control sections using the same methods and materials.

In spring 1997, visual inspection of the research site showed like-new condition, except for one thermal crack. According to the FWD deflection data taken in spring 1997, the EMC² section appeared to be a problem. The control section appeared to exhibit about 2.2 times the service life potential of the EMC² section. The EMC² seems to have softened the subbase layer.

In the summer of 2001, backcalculation of moduli using FWD deflection data revealed that the unstabilized subbase in the control section is about 30% stiffer than the EMC² stabilized subbase.

Therefore, it was found that the use of this particular additive in the subbase did not improve the structural performance of this experimental roadway section (covered with an asphalt surface treatment in the form of a high float surfacing). It might also be possible that the control section contains undisturbed sublayers of asphalt concrete, which could act as subgrade reinforcement, actually strengthening the section.
Estimated Pavement Life
Ak.Hwy., Station 392+00 to 4634+95

Research Project 97–15 & Experimental Feature AK 84–01

[Graph showing estimated pavement life over deflection location number.]

Figure 2.

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Estimated Pavement Life
Ak.Hwy., Station 392+00 to 4634+95

[Graph showing estimated pavement life over deflection testing dates.]

Figure 5.
Estimated Pavement Life
Ak.Hwy., Station 382+00 to 4634+95

Figure 4.
APPENDIX

Specification Special Provisions 302 and 727, Describing the EMC² Stabilization Treatment & Materials Requirements
involved shall be full compensation for all labor, materials, and equipment necessary to perform the work outlined herein.

10/26/94
Add the following: All foreslopes and backslopes which are to be seeded shall be "track walked" prior to the application of seed mix. "Track walking" will consist of the operation of a tracked vehicle, of a type and size approved by the Engineer, on the slopes in such a manner as to leave a uniform covering of cleat indentation in the slope face which are as near to parallel with the roadway centerline as practicable. Turns shall be as gradual as possible and accomplished such that disturbance to the slope face is kept to a minimum. "Track walking" will not be measured or paid for directly but will be considered subsidiary to other Section 203 pay items.

03/29/89
203-4.01 METHOD OF MEASUREMENT. Add the following to the fourth paragraph: Borrow will not be weighed or used while free moisture is observed draining from the haul vehicle at the scale location.

SECTION 205
EXCAVATION, BACKFILL, AND FOUNDATION FILL FOR STRUCTURES

205-5.01 BASIS OF PAYMENT. Add the following: There will be no Excavation for Structures paid for under this section. Excavation for Structures will be subsidiary to Item 202(1), Removal of Structures and Obstructions.

SECTION 302
SUBGRADE MODIFICATION

Delete this section in its entirety and substitute the following:

302-1.01 DESCRIPTION. This work shall consist of scarifying the existing road surface; furnishing EMC² soil stabilizer in a water solution on the prepared surface; mixing embankment materials and stabilizer solution; compacting the mixture to the lines, grades and dimensions as shown on the drawings; and upon completion, providing a surface that is smooth and in reasonably close conformity to the typical section, lines and grades as shown on the plans. A 4 inch subbase and high float asphalt surface treatment will be placed over the subgrade modification.

302-2.01 MATERIALS. EMC² for subgrade modification shall conform to the requirements of Special Provision Subsection 727-2.04, EMC² Soil Stabilizer.

Stabilizer-treated aggregate will be accepted based on random samples taken from the roadway following mixing but prior to compaction.

SPECIAL PROVISIONS
Project No. BRF-I-IM-0A1-1(9)/65748
Alaska Highway MP 1222 North
CONSTRUCTION REQUIREMENTS

302-3.01 PROCESSING AND MIXING. Asphalt surfacing materials shall be taken up and crushed to a size which passes a 2-inch sieve prior to blending with the underlying material. The underlying aggregate surface shall be ripped, scarified, disced and/or rototilled to provide a well-pulverized mixture to a depth of 12 inches.

Application of the stabilizer solution shall be limited to the area of processed materials specifically shaped and sized to receive the solution, and it shall be limited to such an area, of limited size, so that all operations including mixing and compaction can be continuous and completed in one day. If overnight temperatures will not drop below 32°F, it is the Project Engineer’s option to allow treated material to remain in a stockpile or windrow overnight with the precaution that moisture must still be properly adjusted for compaction operations.

The EMC² stabilizer shall be applied at a rate of one gallon per 13 cubic yards of material to be treated. The tolerance from the specified addition rate will be ± 10 percent. Water in the amount calculated to bring the soil or aggregate material to be treated to optimum moisture content, as determined by ASTM D 1557, shall be mixed with the EMC² prior to application (forming the EMC² solution). Water should not be added to the aggregate material prior to adding the EMC² solution, i.e., do not prewet the aggregate mixture ahead of applying the EMC² solution. If the material to be treated is already at or above optimum moisture content, it must be dried to two percentage points below optimum in preparation for addition of the EMC² solution. Further, if the material is already close to optimum moisture content, no less than one percent moisture must be added as part of the EMC² solution in order to properly disperse the highly concentrated stabilizer. A metered pump shall be used to add the stabilizer to the water. The capacity of the mixing tank should be determined to allow for accurate proportioning of the EMC² solution. The water tank shall be partially filled with water, the stabilizer added, then the remainder of the water. The turbulence of the water addition will provide adequate mixing action to prepare the solution.

The EMC² solution shall not be applied or mixed with the aggregate material if the atmospheric temperature is below 50°F, or when conditions indicate that the temperature will fall below 32°F, within 24 hours. Unless otherwise indicated by the Project Engineer, application of the EMC² solution shall be limited to periods when rainfall is not expected during the application or during the 24 hour period following the application.

EMC² stabilizer is stable in storage as long as it is protected from freezing and the air-tight seal is maintained on the shipping container. The stabilizer should be gently mixed to the full depth of the shipping container with a rod or low-pressure aeration system before use. The mixed EMC² solution shall not be used if, during the period of time between mixing and application, the solution has been exposed to the open air for more than 6 hours.

It is critical to the stabilization process that the EMC² solution be thoroughly dispersed and mixed with the aggregate material. The EMC² solution shall be

SPECIAL PROVISIONS
Project No. BRF-I-IM-0A1-1(9)/65748
Alaska Highway MP 1222 North

25
applied to the material to be treated by a pressurized spreader truck or a water truck with a pressurized spreader bar and an accurate speedometer to ensure uniform distribution of the EMC² solution. The Engineer may approve other water spray equipment that can be demonstrated to provide a uniform spray pattern. Thorough wetting may require placement of the treated material into windrows followed by blademix processing until it is homogeneously moisturized. The aggregate material and EMC² solution shall be thoroughly mixed by a tractor-drawn spike, disc harrows or a cross-shaft rotary mixer. Mixing by motor grader scarification teeth or by blade-mix processing may be allowed. Mixing equipment shall follow no more than a quarter mile behind the spray application truck.

EMC² solution should be added in increments and mixing continued so as to carefully approach optimum moisture content. If the entire quantity of EMC² solution allotted for a designated volume of material to be treated has been added without achieving a homogeneously wetted mixture within the range of allowable moisture content, then water shall be added to the mixture to bring it within specified tolerances using the same attention to uniform distribution as was given to the EMC² solution.

302-3.02 COMPACTION. Compaction operations can begin immediately following attainment of proper mixing and moisture content of the treated material. The material shall be spread uniformly to the required cross section and compacted in accordance with Subsection 203-3.03. The maximum allowable thickness of each lift shall be 6 inches.

Pneumatic-tire rollers, static steel-wheel rollers, or vibratory steel-wheel rollers may be used to construct the final compacted surface.

Compaction operations shall continue and the treated material shall be maintained within the specified range of moisture content until the specified density has been achieved. All areas of treated materials shall be given a minimum of six complete coverages of the roller equipment.

302-3.03 FINISHING AND CURING. Upon completion, the surface shall be smooth, and in conformity with the typical section, lines, and grades as shown in the plans. The surface will be tested after final rolling at selected locations using a 10-foot straightedge. The variation of the surface from the testing edge of the straightedge, between any two contacts with the surface, shall not exceed 1-¼ inch. The surface of the completed subgrade shall be satisfactorily maintained until the base course has been placed. For a minimum of 24 hours after the completion of subgrade compaction or until the base course is placed, the Contractor shall control traffic movement over the freshly treated subgrade surface so as to prevent rutting or other displacement of the treated materials.

302-4.01 METHOD OF MEASUREMENT. EMC²-treated aggregate for subgrade modification will not be measured for payment but will be subsidiary to this item.

Processing for subgrade modification will be measured by the station and shall include all scarifying and pulverizing of the existing surface; obtaining EMC² stabilizer and preparing EMC² solution; all placing and mixing of materials on the road; disposal of unsuitable material; the compacting of materials; the

SPECIAL PROVISIONS
Project No. BRF-I-IM-0A1-1(9)/65748
Alaska Highway MP 1222 North 26
11/25/92

724-2.02 MATERIALS. Add the following to Table 724-1:

<table>
<thead>
<tr>
<th>Seed Type</th>
<th>Germination Period</th>
<th>Percent Purity</th>
<th>Percent Germination</th>
<th>Percent Sprout-able Seed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glaucus</td>
<td>14 days</td>
<td>95</td>
<td>80</td>
<td>76</td>
</tr>
<tr>
<td>Bluegrass</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SECTION 727

SOIL STABILIZATION MATERIAL

Add the following subsection:

727-2.04 EMC\(^2\) SOIL STABILIZER. The material shall be EMC\(^2\), as supplied by the Soil Stabilization Products Company, Inc., Merced, CA, 1(800) 523-9992. The stabilizer shall be water soluble and formulated specifically for stabilization of soils, select fill materials and aggregates used in the construction of earthworks.

The EMC\(^2\) shall be certified as being nonhazardous, non-toxic, nonflammable, and noncorrosive - within the limits normally acceptable for materials used in roadway construction. The stabilizer shall be safe for handling without the use of protective breathing apparatus or protective clothing. A standard Material Safety Data Sheet shall be furnished by the manufacturer. The manufacturer shall also provide documentation certifying that there are no detectable organic solvents or identifiable EPA 8270 target compounds in the stabilizer, based on U.S. EPA 7000 Series (TTLC or CAM17) for metals and Method 8270. The materials supplier shall provide the Engineer with a certification of compliance with these requirements when the EMC\(^2\) is delivered to the project site.

The EMC\(^2\) shall be protected during transportation and storage against freezing. An airtight seal shall be maintained to protect against air contamination. Any product which has been subjected to freezing temperature or left open to air contamination will be rejected.

A sampling of EMC\(^2\) stabilizer delivered to the project may be taken by the Engineer to validate adherence to specifications.
finishing of the surface; and the maintenance of the completed surface when applicable.

Water as required for compaction and maintenance will not be measured for payment but will be considered a subsidiary obligation.

302-5.01 BASIS OF PAYMENT. The accepted quantities of Subgrade Modification will be paid for at the contract unit price per station for processing.

Payment will be made under:

<table>
<thead>
<tr>
<th>Pay Item No.</th>
<th>Pay Item</th>
<th>Pay Unit</th>
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<tbody>
<tr>
<td>302(3)</td>
<td>Processing for Subgrade Modification</td>
<td>Station</td>
</tr>
</tbody>
</table>

SECTION 303

RECONDITIONING

303-1.01 DESCRIPTION. Delete this subsection and substitute the following:
This work consists of reconditioning and ditch reconditioning. Reconditioning includes blending and scarifying the existing roadway surface and spreading embankment to achieve grade before placing new embankment materials (such as in Typical Section 1A). Reconditioning also includes preparation of the roadway to receive new materials when spreading embankment is not required. Ditch reconditioning includes cleaning and regrading ditches, shaping shoulders, grading and shaping backslopes, repairing berms, filling depressions and thaw ponds along the toe of embankment, and performing slope work in conformance with the plans.

303-2.01 CONSTRUCTION REQUIREMENTS. Delete the second paragraph and substitute the following: Where asphaltic material is present in existing roadway to be incorporated in the new embankment use the following procedure for compaction:

1. Construct a conformance strip with dimensions of 500' by 18' at a location directed by the Engineer.

2. Route approved compaction equipment over the test strip. The Engineer shall take one or more one-minute nuclear density gauge readings on the test strip and shall repeat the readings at the same location(s) until non-increasing density is achieved. Non-increasing density is defined such that the last nuclear gauge reading(s) is within 0.5% of the previous nuclear gauge reading(s). The Engineer shall count the number of passes required for the approved equipment to achieve non-increasing density. Apply this compactive effort to the entire embankment.

3. As directed by the Engineer, add moisture in addition to that existing in the asphalt contaminated material, to facilitate compaction. The amount

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