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TEST REPORT

MIDWEST'S GREENPAVE SYSTEM

FIELD INSTALLED ECOPAVE STABILIZER

VALIDATING CONCEPT OF ECOPAVE SUITABILITY

FOR ROAD CONSTRUCTION

THE EVALUATION OF STRENGTH GAIN IN

ECOPAVE AMENDED UNPAVED ROADS

SCOTTSDALE, AZ

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Summary & Comment

The testing in Scottsdale, AZ strongly suggests that ECOPAVE greatly influences if not dominates the structural performance (lift stiffness and material modulus) of silty sand / soil materials. So much, so that the performance of ECOPAVE stabilized materials can be anticipated, if not predicted. It is therefore possible to develop and implement construction specifications for ECOPAVE stabilized materials that can be widely employed with reasonable confidence even though contractors, site conditions and material sources may vary. This means added value to Midwest's customers since the quality of the in-place installation in addition to the stabilized material can be assured by design.

Summary

The testing of ECOPAVE stabilized roads in Scottsdale, AZ, strongly suggests that ECOPAVE greatly influences, and if not dominates the structural performance (lift stiffness and material modulus) of the materials it is used with. So much, so that the performance of ECOPAVE stabilized materials can be anticipated, if not predicted.

The testing of ECOPAVE stabilized roads in Scottsdale, AZ identify structural improvement of the roads expressed numerically as 14 for non-ECOPAVE road to 18, 21, 23, 27 and 29 for an ECOPAVE stabilized road from time of stabilization to 3 years after stabilization. This demonstrated structural performance improvement benefits the community by creating roads of a quality comparable to paved roads at 10% of the cost. This enables the community roads budget creation of 10 miles of ECOPAVE stabilized roads for every mile of paved road. Given the finite availability of funds for road construction and the enormous demand for paved roads, in part driven by U S EPA mandates on communities in non-attainment areas, the ECOPAVE road program accomplishes a much desired state, community and strategic outcome.

The data developed in this testing establishes it is therefore possible to develop and implement construction specifications for ECOPAVE stabilized materials that can be widely employed with reasonable confidence even though contractors, site conditions and material sources may vary. This means added value to Midwest's customers since the quality of the in-place installation in addition to the stabilized material can be assured by design.

The testing also identified significant structural improvement provided by the ECOPAVE stabilization of a sandy unpaved road. Stabilization provides for an increase in a road's resistance to deformation (stiffness) in reaction to traffic loading. The stiffer and uniformly stiff a roadway is, the longer period of time between repairs. Soon after ECOPAVE stabilization, stiffness increased to an average of ~23 MN/m with a uniformity represented by a coefficient of variation of ~16%. This is equivalent to a quality low traffic volume road paved with several inches of HMA. Later in life, the ECOPAVE stabilized roads demonstrated stiffness expected of a moderate volume paved road. This demonstrated structural performance improvement has the potential benefit of facilitating the construction of roads of a quality comparable to paved roads at 20% of the cost with fewer traffic interruptions. Five (5) miles of ECOPAVE stabilized roads can be constructed for every mile of paved road. Given the limited funds for road construction and the enormous demand for paved roads, in part driven by U.S. EPA mandates on communities in non-attainment areas, ECOPAVE road stabilization can provide a cost effective, high quality alternative to conventional paving on low to moderate volume roads.

Introduction

Two days of testing were conducted during the 9th and 10th of May with the Midwest Samitron on five (5) sections of an ECOPAVE amended unpaved road in Scottsdale, AZ. The testing was performed at the request of Midwest Industrial Supply, Inc. Dennis Casamatta of Midwest and Melvin Main of Main Associates performed the testing. Marty Koether of EarthCare Consultants arranged for access to the roads tested.

Objective

The objective of the testing was to demonstrate that the performance of an ECOPAVE amended unpaved road is sufficiently well behaved to be predictable. This testing was intended as a precursor to the development of construction specifications test methods by Midwest to evaluate if not control the in-place quality of highway materials amended with Midwest products using in-place stiffness and achieving intended, predictable structural performance.

Test Sites

Main Associates tested Five (5) sites per the February 26, plan developed for Midwest. These sites were:

Site 1: Davis Rd., ~200' west of intersection Scottsdale Rd., ~1 day & 2 days old (days after ECOPAVE installation)

Site 2: 71st St., ~200' north of intersection with Windstone, ~2 days old

Site 3: Via Donna Rd., ~500' east of intersection with Scottsdale Rd., ~2 months old

Site 4: 76th St., ~200' south of intersection with Via Donna, ~ 2 yr. old

Site 5: Via Donna Rd., ~50' east of Hayden, ~3 yr. old

The soil at each site was silty sand, AASHTO A-2-4. Each site was sealed with two coats of the same dilution.

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Tests Performed

Sixteen (16} Samitron measurements were made at each site (Appendix 1). Photographs of the testing are presented in Appendix 2. Measurements on all sites required the use of moist sand to seat the Samitron, as the surface was often hard and dry. The measurement data is presented in Table 1.

Table 1: Measurement Data

Test Location	Stiffness MN/m						
	Test Site 1 (~ 24 hr.)	Test Site 2 (~ 48 hr.)	Test Site 3 (~ 2 months)	Test Site 4 (~ 2 yr.)	Test Site 5 (~ 3 yr.)	Test Site 1 (~ 48 hr.)	All 48 hr. Data
1	17.21	17.53	19.56	26.85	25.39	27.42	
2	19.95	15.12	15.49	28.67	38.30	22.43	
3	18.04	15.96	24.44	24.80	30.23	15.74	
4	14.72	16.30	25.97	28.17	37.89	18.21	
5	13.98	19.94	28.87	26.50	28.65	24.63	
6	17.42	14.43	19.46	27.12	27.74	25.14	
7	16.34	24.45	25.87	21.74	20.47	21.62	
8	14.90	18.68	24.30	24.51	24.27	19.14	
9	16.89	21.62	26.96	31.51	33.29	18.69	
10	15.82	13.26	20.97	31.71	29.26	22.37	
11	18.00	22.33	22.69	25.34	23.32	23.61	
12	17.25	24.37	26.96	23.14	29.19	20.32	
13	17.36	23.12	26.09	31.71	34.61	23.51	
14	16.54	14.80	19.84	28.13	32.54	27.38	
15	19.40	20.98	20.91	27.68	27.68	27.22	
16	27.27	18.53	22.94	26.41	23.84	23.57	
Average	17.57	18.84	23.21	27.12	29.17	22.56	20.70
Standard Deviation	3.03	3.68	3.60	2.91	5.16	3.47	4.00
COV (%)	17.27	19.55	15.53	10.74	17.70	15.38	19.30
Ž re Site 1 Average, %		7.23	32.10	54.40	66.02	28.43	17.83

RESULTS AND ANALYSIS

When the test results for the ECOPAVE amended silty sand are graphically represented, the mean stiffness for all five sites, representing 3 years of aging, lie on the same logarithmic curve with a high degree of correlation (Figure 1). Since the cure rate of most materials is logarithmic, this data strongly suggests that the rate of strength gain is very consistent between the sites. More importantly, this suggests that the performance of the ECOPAVE road is predictable. The uniformity of roadway stiffness is higher than most sites Main Associates has evaluated. A uniformity represented by a coefficient of variation of ~3% for in-place material stiffness is considered ideal by the FWHA. The largest coefficient for the amended silty sand is 19.6%.

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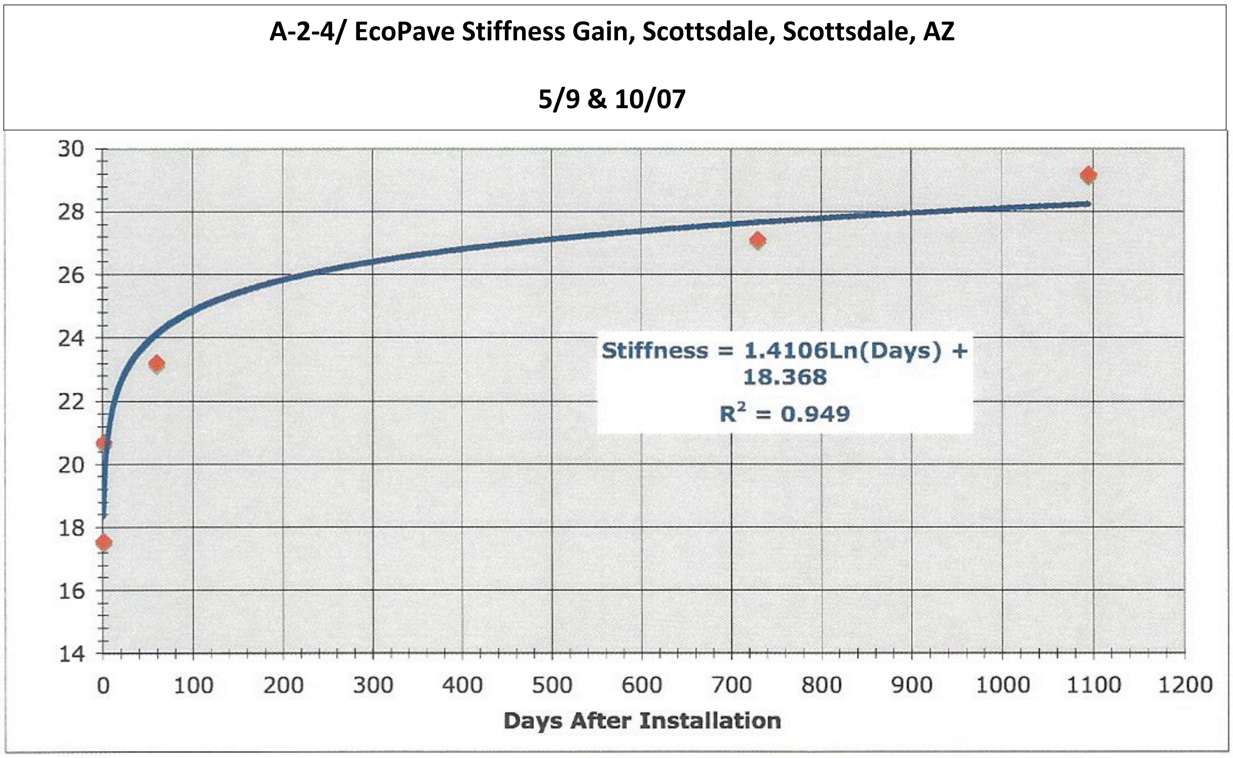
Site Conditions

The weather on May 9th and 10th was sunny and dry, temperature in the 80s and winds below 5 mph. During both days, low traffic volume was experienced (< 10 vehicles per hour).

Figure 1



Samitron Bias & Precision

Samitron operation was verified on its inertial isolated mass before each day of testing. A coefficient of variation (COV) of less than 1% about the expected value of stiffness was measured on the mass for 3 Samitron measurements. Samitron measurements were repeated at Site 1 to evaluate measurement precision. At this site, the COV for 3 measurements was 3.3%. A COV of less than ~ 10% is considered good for most in-place geotechnical measurements.

Conclusions and Recommendations

Samitron measurements are readily able to quantify the rate of strength (stiffness) gain for the ECOPAVE amended silty sand. Judging from the consistency and uniformity of Samitron measurements, there is apparently good control of native material, stabilization (amendment with ECOPAVE) and compaction. Samitron measurements indicate that the rate of strength gain is predictable.

It is therefore possible to quantify from empirical Samitron data the needed roadway strength or stiffness. Using the Samitron, a prepared unpaved road can be evaluated as to whether it needs stabilization or not. If it does, then Samitron measurements can quantify the amount of stabilization (stiffening) achieved.

CBR measurements of stabilization on molded laboratory samples could be used to customize mixes for a variety of materials and related to expected in-place stiffness .[1] Using the Samitron on the same laboratory samples, cures rates (rate of strength gain) can also be defined. These laboratory measurements can be used to define the short-term strength gain of in-place stabilized materials and predict when the material can be released to loading and what its ultimate strength will be.

This approach to controlling the quality of stabilized materials with the Samitron could end the guess work of what material needs stabilization, determine when a materials' is sufficiently stabilized and predict material performance in response to loading. All of which amounts to higher materials quality, lower cost and lower construction time.

Appendix 3 is a recommendation of how the in-place performance in terms of stiffness should be defined and evaluated for an ECOPAVE amended AASHTO A-2 soil. It is based on the recent testing in Scottsdale, AZ. It is assumed that the performance of the Scottsdale roads is satisfactory and typical. It is also preliminary until additional tests, like those done in Scottsdale, can be done on the same soil class on jobs elsewhere in the United States.

1 Assessment of In-Situ Test Technology for Construction Control of Base Courses and Embankments, 2004, Murad Y. Abu-Farsakh, Ph.D.,P.E.,Khalid Alshibli,Ph.D.,P.E, Munir Nazzal,and Ekrem Seyman, Louisiana Transportation Research Center, Baton Rouge, LA 70808, FHWA/LA.04/385

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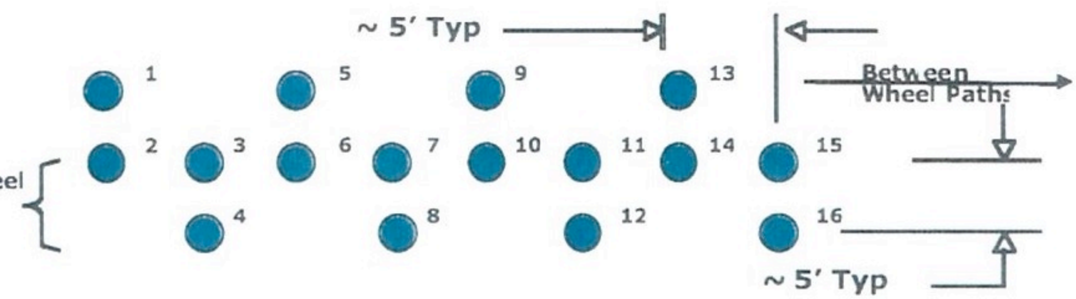
Appendix 1

Stiffness Measurement Sampling

Sampling Pattern for All Sites



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Attachment 2

Photographs of Testing

Site 2 Looking South

Site 2 Looking South

Site 3 Looking East

Site 3 Looking West

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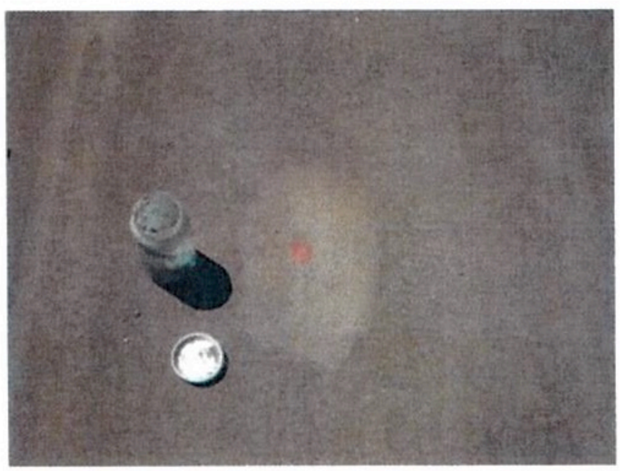
Site 4 Looking North

Site 4 Looking South



Site 4 Surface

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Site 5 Looking East

Site 5 Looking West

Site 5 Surface