STATE OF FLORIDA

Performance Report of Micro-surfacing Experimental Project US-319/SR-369 in Leon County

Research Report
FL/DOT/SMO/13-557

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STATE MATERIALS OFFICE

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INTRODUCTION

In the latter part of 2008, the Florida Department of Transportation, herein referred to as the Department, initiated the process of planning and constructing an experimental project utilizing micro-surfacing. This was done to evaluate an alternative to conventional milling and resurfacing with hot-mix asphalt (HMA) that could be used to potentially extend the life of the pavement three to five years prior to a more extensive rehabilitation. Micro-surfacing is an emulsion based asphalt mixture applied at a lower spread rate than HMA and is designed to extend the life of an existing pavement structure without major rehabilitation. Though micro-surfacing has been used frequently by city and county agencies, the Department has very little experience with this pavement rehabilitation technique.

The Department, in cooperation with Industry, developed a micro-surfacing specification and selected a test location on US-319/SR-369 south of Tallahassee. This report will document the planning, construction, and post-construction testing of the test project.

PROJECT INFORMATION

The project is a portion of US-319 that begins at the Leon/Wakulla County line and extends north 1.627 miles (see Figure 1). The roadway consists of two lanes (one in each direction) 12 ft. wide with 4 ft. wide paved shoulders. The two-way average annual daily traffic (AADT) at the time of construction was 13,500, with an equal split in traffic for each direction. The predicted compounded traffic growth rate is 3.9% per year. This is considered a low volume state highway, with 2009 equivalent single axle loads (EASLs) of 100,000.

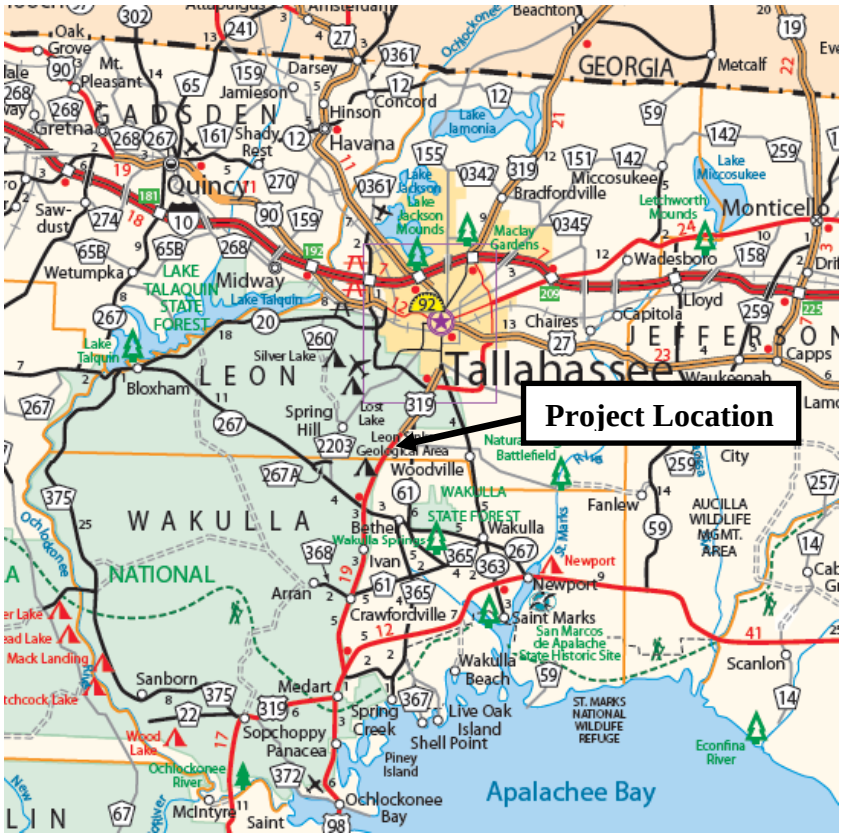


Figure 1 – Map of Project Location

The financial project number is 424616-2-52-01. The contract was awarded to Florida Highway Products, Inc. of Celebration, FL on 11/09/09. Paving stared on 03/30/10 and lasted two days. Final acceptance of the project occurred on 05/19/10. The contract amount was $168,376.79.

The project was last paved in 1994 and was in fair condition in 2009, with the only distress type of concern being top-down cracking. The 2009 Pavement Condition Survey (PCS) ratings for rutting, cracking, and ride are shown in Table 1. A value of 6.5 is considered the minimum acceptable level for a particular distress. As shown in Table 1, the cracking rating was at the threshold of the minimum acceptable level. A representation of the severity of the

cracking is shown in Figure 2. The cracks in the photograph have been filled by Florida Highway Products prior to micro-surfacing.

This project was selected because it had the type and severity of distress that micro-surfacing can reportedly be used to correct. Micro-surfacing would cover the cracks, fill the very minor ruts (1/8" deep), and provide a smooth wearing surface that would ideally last for several years.

Table 1 – Pavement Condition Data from 2009 Survey Prior to Micro-surfacing

Rating (Maximum = 10.0)		
Rutting	Cracking	Ride
9.0	6.5	8.0

Figure 2 – Typical Representation of Cracking

SPECIFICATION DEVELOPMENT

In late 2008/early 2009, a developmental specification for micro-surfacing (DEV 335) was created for this project (see Appendix A). Numerous meetings and correspondence with several micro-surfacing contractors/suppliers occurred prior to developing the final version of the specification. Many International Slurry Surfacing Association (ISSA) criteria were adopted. An ISSA Type II mixture gradation was chosen and a single lift, at a spread rate of 20 - 26 lb/sy, was specified. Further details related to the requirements for mix design, construction, and acceptance can be found in the attached specification.

MIX DESIGN

The mix design was developed by ArrMaz Custom Chemicals, Inc. of Mulberry, FL under contract with Florida Highway Products. The design utilized a CSS-1hP (polymer modified) emulsion and a granite screenings from Macon, GA. The mix design gradation, emulsion content, and residual asphalt content are shown in Table 2. Further mix design information is located in Appendix B.

Table 2 - Mix Design Gradation and Binder Information

Sieve Size	% Passing	
3/8"	100.0	Emulsion Content, % 12 +/- 0.25
#4	99.5	
#8	76.2	
#16	51.4	Residual Asphalt Content, % 7.94 +/- 0.16
#30	34.8	
#50	23.9	
#100	15.4	
#200	8.9	

CONSTRUCTION DATA

Emulsion Testing

Two samples of emulsion were tested, one sent by the manufacturer (ArrMaz Custom Chemicals) before construction started and one sampled from the tanker truck at the project site during construction.

The sample sent by the manufacturer passed all of the test requirements, except for the storage stability test, which measured 3.0%, with a maximum specified value of 1.0%. AASHTO specification requirements for this product allow this requirement to be waived, therefore the emulsion was approved and the manufacturer was assigned a pre-test number for this emulsion. The emulsion sample obtained at the project site passed all of the test requirements, including the storage stability test.

Crack Sealing

Prior to the start of construction, Florida Highway Products sealed the majority of the cracks that were present in the pavement using a PG 67-22 binder. Though the specifications only required sealing of cracks greater than 1/4" in width, many cracks less than 1/4" in width were also sealed. According to the contractor's superintendent, a total of 490 gallons of binder were used for crack sealing.

Weather Conditions

The air temperature for the first day of paving (March 30, 2010) started below 45°F. Construction did not start until the air temperature reached 45°F at approximately 10 AM. The

mixture temperature was 55°F and the surface temperature was 72°F at 11 AM. The day was sunny. Exact weather conditions at the site for the second day of construction were not reported.

Aggregate Handling and Laydown Operations

At the southern end of the project, on property adjacent to the roadway, aggregate materials were stockpiled and subsequently sieved over a 3/8" screen deck and stockpiled separately. The particles smaller than 3/8" in size were then hauled to the paving machine, as needed. During laydown operations, the average dry aggregate spread rate was 23.3 lb/sy, which is near the middle of the specified range of 20-26 lb/sy. Utilizing a ruler, the average thickness of the micro-surfacing (aggregate plus emulsion) was 1/4".

The construction operation lasted two days and went very well. All Department personnel that were present during construction were pleased with the construction operation and the appearance of the final product.

Production Mixture Test Results

Samples of the mixture were obtained from the paver on the first day of production and were tested at the Department's State Materials Office (SMO) for asphalt binder content and gradation using Florida Test Methods FM 5-563 and FM 1-T 030. The results met all specification criteria and are shown in Table 3. No additional samples were tested by the Department.

Table 3 - Production Mixture Test Results

Sieve Size	Gradation (% Passing)	
	Mix Design	Production
3/8"	100.0	100.0
#4	99.5	99.5
#8	76.2	75.7
#16	51.4	50.3
#30	34.8	34.8
#50	23.9	23.8
#100	15.4	13.9
#200	8.9	8.3
Residual binder content (%)	7.9	8.3

Friction Test Results

Friction testing was performed in the northbound direction on August 4, 2009, as part of routine inventory testing. Post construction friction testing was performed in both the northbound and southbound directions on April 21, 2010 and again in the northbound direction on June 23, 2010. All friction tests were performed at 40 mph, using a ribbed tire, in the wet condition. Results are shown in Table 4. All of the results are considered to be very good.

Table 4 - Friction Test Results

Date	Direction	Friction Value (FN40R)
8/4/09 Pre-construction	Northbound	46
4/21/10 Post-construction	Northbound	51
	Southbound	45
6/23/10 Post-construction	Northbound	48

PCS Data

Pavement condition surveys were conducted in the northbound direction on October 29, 2009 prior to construction and in the northbound and southbound directions on April 13, 2010 after

construction. Results are shown in Table 5. The southbound direction experienced 0.12" of rutting within two weeks of construction, resulting in a rut rating of 9.0, instead of 10.0. Maximum crack ratings of 10.0 were obtained for both directions. Ride ratings of 8.8 and 8.6, which are considered good ratings, were achieved for the northbound and southbound directions, respectively.

Table 5 – Pavement Condition Data Before and After Micro-surfacing

Date	Direction	Rating (Maximum = 10.0)		
		Rutting	Cracking	Ride
10/29/09 Pre-construction	Northbound	9.0	6.5	8.2
4/13/10 Post-construction	Northbound	10.0	10.0	8.8
	Southbound	9.0	10.0	8.6

CONCLUSIONS

The planning and construction for this micro-surfacing project went very well and post-construction test results were excellent. This particular section of roadway is a good candidate for the evaluation of micro-surfacing as a rehabilitation technique that can potentially extend the life of the pavement three to five years prior to a more extensive rehabilitation.

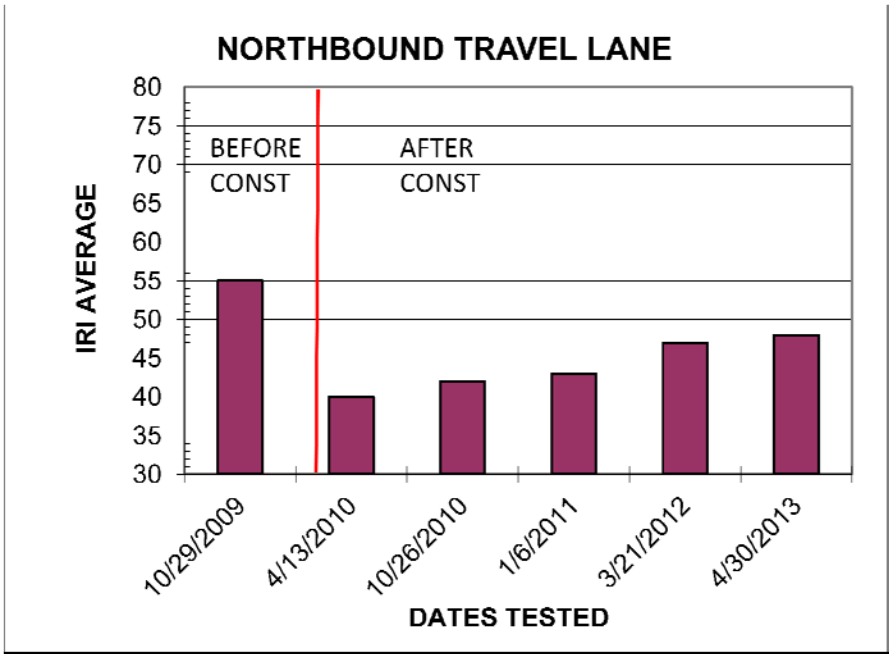
At this point, the Department has not established a policy for the use of micro-surfacing. This project will need to be further evaluated and perhaps another test section constructed prior to establishing a policy. In addition, the Department has a resurfacing program thoroughly established based on milling and resurfacing with HMA. Integrating a rehabilitation technique with a much shorter lifespan than HMA will require careful planning and consideration.

FOLLOW-UP PAVEMENT CONDITION SURVEYS (PCS)

Figures 3-6 show the PCS survey results for an additional four review periods past the post-construction survey and represent the pavement condition through April 2013. As of April 2013, the micro-surfacing treatment was three years old. The following pavement condition characteristics were measured: 1) International Roughness Index (IRI) and Ride Number (RN) for pavement smoothness, 2) Rut depth, and 3) Crack rating. Ratings for both northbound and southbound directions are shown.

With respect to pavement smoothness, both the IRI and RN values (Figures 3 and 4, respectively) showed a steady increase in pavement roughness (indicated by increasing IRI and decreasing RN). Rutting (Figure 5) is minimal and has not changed significantly over the past several years. The crack rating (Figure 6 and Table 6) was constant through 2012 but did decrease (worsen) significantly from 2012 to 2013.

Based on these trends, it appears that the micro-surfacing treatment for this roadway will last 4-5 years before becoming deficient with respect to its crack rating (crack rating less than 6.5).


NORTHBOUND TRAVEL LANE
IRI AVERAGE
80
75
70
65
60
55
50
45
40
35
30
BEFORE CONST
AFTER CONST
10/29/2009
4/13/2010
10/26/2010
1/6/2011
3/21/2012
4/30/2013
DATES TESTED

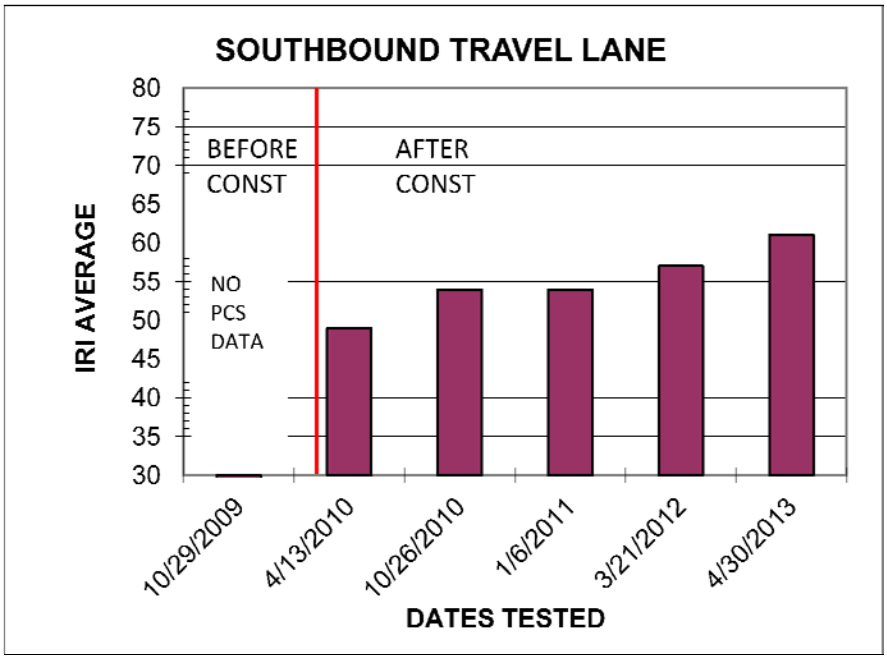
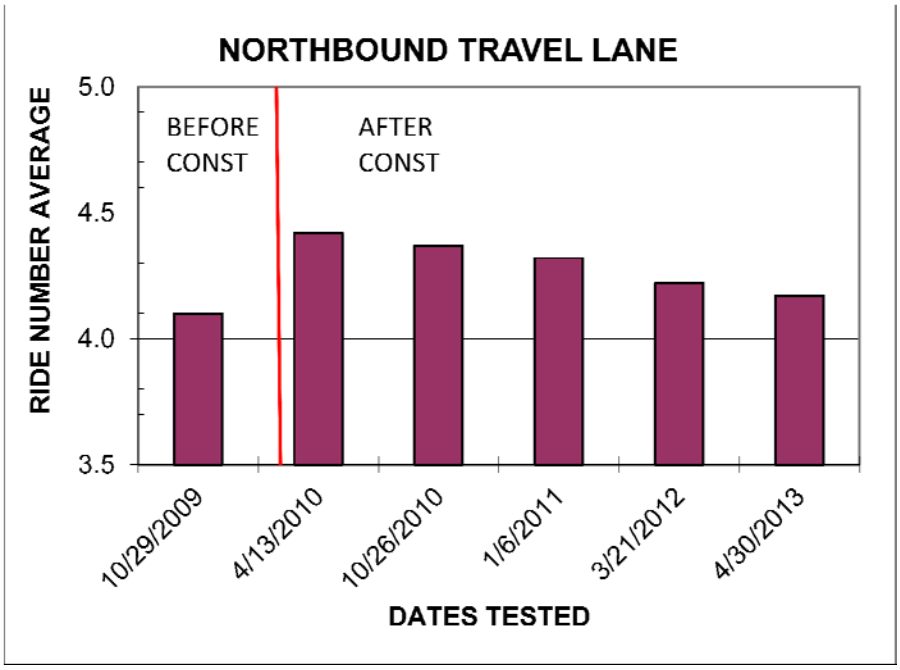

SOUTHBOUND TRAVEL LANE
IRI AVERAGE
80
75
70
65
60
55
50
45
40
35
30
BEFORE CONST
AFTER CONST
NO PCS DATA
10/29/2009
4/13/2010
10/26/2010
1/6/2011
3/21/2012
4/30/2013
DATES TESTED

Figure 3. IRI



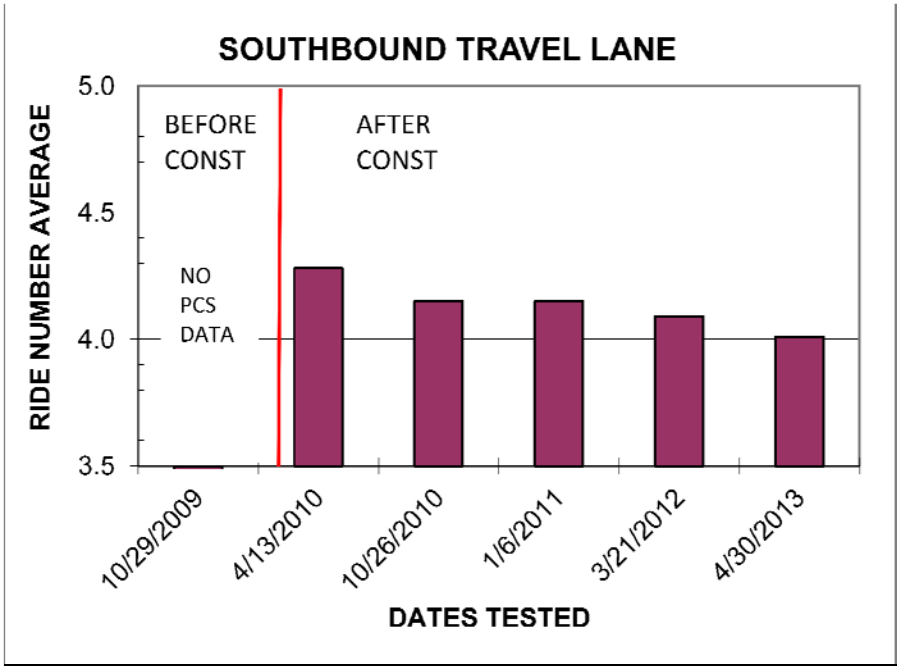
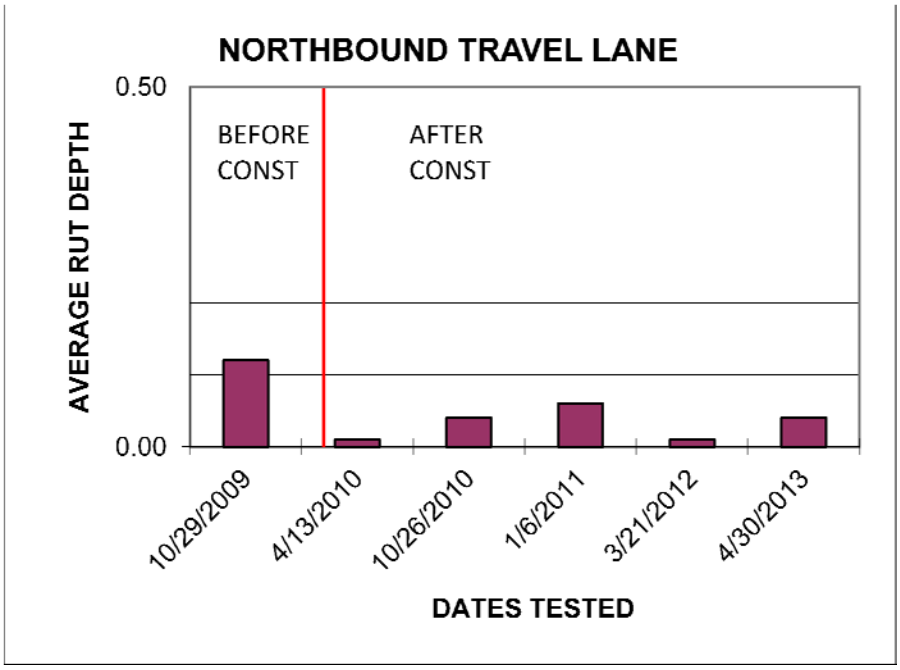


Figure 4. Ride Number



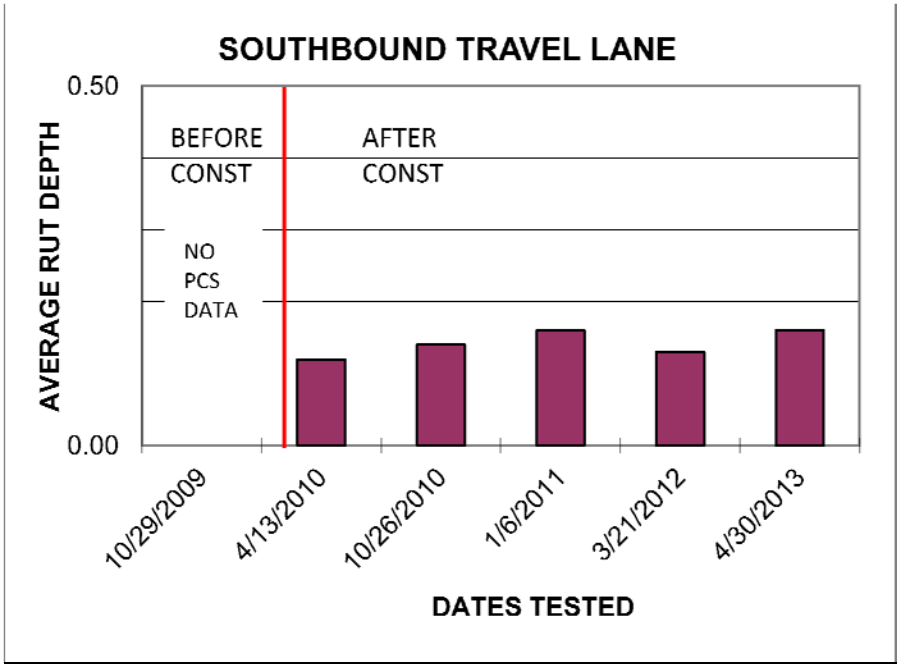
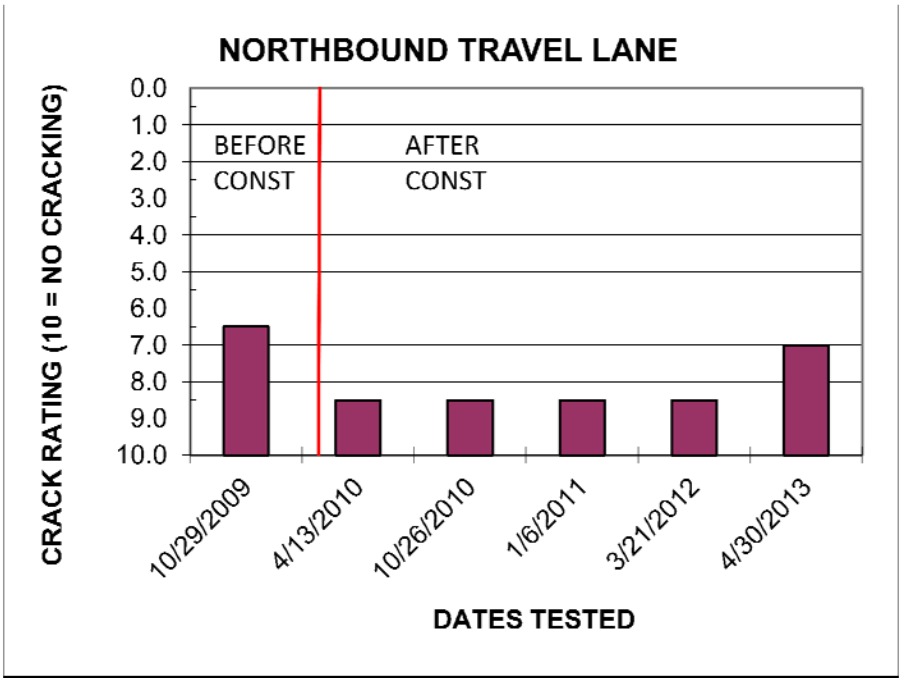


Figure 5. Rut Depth



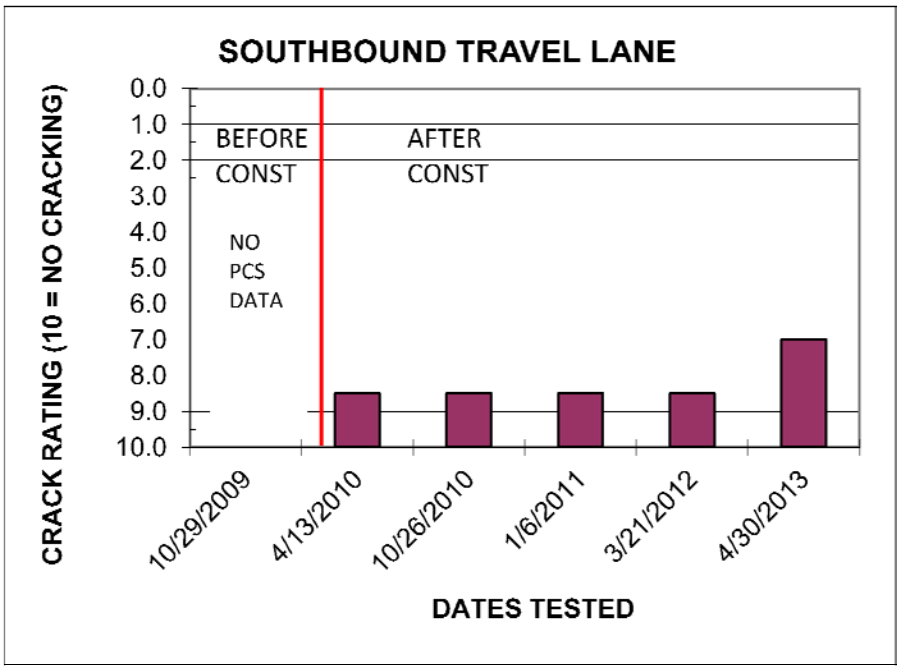


Figure 6. Crack Rating

Table 6. Comments from Crack Surveys

Date Tested	Northbound	Southbound
10/29/2009	* PCS Data prior to construction	No PCS Data for Southbound composite roadway
4/13/2010	All cracks are sealed. 10% C1B CW and CO	All cracks are sealed. 10% C1B CW and CO
10/26/2010	Sealed cracks beginning to crack through sealant. 10% C1B CW and CO	Sealed cracks beginning to crack through sealant. 10% C1B CW and CO
1/6/2011	Cracks showing through sealant. 10% C1B CW and CO	Cracks showing through sealant. 10% C1B CW and CO
3/21/2012	Cracks showing through sealant. 15% C1B CW and CO	Cracks showing through sealant. 18% C1B CW and CO
4/30/2013	Significant new 1B cracking (unsealed). 40% CO, 50% CW	Significant new 1B cracking (unsealed). 40% CO, 50% CW

APPENDIX A

Developmental Specification for Micro-surfacing

MICRO-SURFACING.
(REV 1-20-09)

PAGE 279.The following new Section is added after Section 334.

SECTION 335
MICRO-SURFACING

335-1 Description.

Construct a micro-surfacing pavement with the type of mixture specified in the Contract. Meet the general construction requirements of Section 330, except as modified herein. Micro-surfacing is a mixture of polymer-modified asphalt emulsion, mineral aggregate, mineral filler, water, and other additives, properly proportioned, mixed and spread on a paved surface.

The mix shall be capable of being spread in variable thickness cross-sections (wedges, ruts, scratch courses and surfaces) which, after curing and initial traffic consolidation, resists compaction throughout the entire design tolerance range of asphalt binder content and variable thickness to be encountered. The end product should maintain a skid-resistant surface in variable thick sections throughout the service life of the micro-surfacing.

The mix shall be a quick-traffic system that will be able to accept traffic two hours after application. Longer time periods will be acceptable, if approved by the Engineer.

335-2 Materials.

335-2.1 Emulsified Asphalt:

335-2.1.1 General Requirements: Provide a quick-traffic, polymer-modified asphalt emulsion conforming to the requirements specified in AASHTO M 208 for CSS-1h. The cement mixing test shall be waived for this emulsion.

The polymer material shall be milled or blended into the asphalt or emulsifier solution prior to the emulsification process.

The minimum amount and type of polymer modifier shall be determined by the laboratory performing the mix design. The minimum amount required will be based on the asphalt content (by weight) and will be certified by the emulsion supplier; however, the amount shall not be less than three percent polymer solids.

The Engineer may waive the five-day settlement test, provided job-stored emulsion is used within thirty-six hours from the time of the shipment or the stored material has had additional emulsion blended into it prior to use.

335-2.1.2 Quality Tests: Meet the requirements of AASHTO M 208 for CSS-1h emulsion, plus the following criteria shown in Tables 335-1 and 335-2.

Table 335-1
Quality Tests for Asphalt Emulsion

AASHTO Test No.	Emulsion Property	Specification Requirements
AASHTO T 59	Residue after Distillation (1)	62% Minimum

(1) Maintain the test temperature below 280°F (138°C).

Table 335-2 Quality Tests for Asphalt Emulsion Residue		
AASHTO Test No.	Residue Property	Specification Requirements
AASHTO T 53	Softening Point	135°F Minimum
AASHTO T 49	Penetration at 77°F	40 – 90 dmm

335-2.1.3 Sampling, Certification, and Verification: For the first load of emulsified asphalt produced for the project, the supplier shall submit a sample to the State Materials Office for testing before use. A pretest number will then be assigned by the State Materials Office, which shall be furnished with all emulsified asphalt delivered to the project.

The Engineer may sample and test all subsequent loads of emulsified asphalt delivered to the project to verify and determine compliance with specification requirements. Where these tests identify material outside specification requirements, the Engineer may require the supplier to cease shipment of that pretested emulsified asphalt product. Further shipment of that pretested emulsified asphalt product to Department projects will remain suspended until the cause of the problem is evaluated and corrected by the supplier as necessary to the satisfaction of the Engineer.

335-2.2 Aggregate:

335-2.2.1 General: Use an aggregate blend which consists of 100% crushed granite. Use aggregates source(s) from the list of granitic aggregates available on the Department's website and also meeting the requirements of this specification. The URL for obtaining the list of granitic aggregates is:
www.dot.state.fl.us/statematerialsoffice/quality/programs/qualitycontrol/materialslistings/sources/frictioncourse.pdf

335-2.2.2 Aggregate Quality Tests: In addition to the requirements of Sections 901 and 902, meet the minimum aggregate requirements of Table 335-3.

Table 335-3 Quality Tests for Aggregate		
AASHTO Test No.	Aggregate Property	Specification Requirements
AASHTO T 176	Sand Equivalent	65 Minimum
AASHTO T 104	Soundness	15% Maximum using Na_2SO_4 or 25% Maximum using $MgSO_4$
AASHTO T 96	Abrasion Resistance (1)	30% Maximum

(1) The abrasion test will be performed on the parent aggregate.

335-2.2.3 Gradation Requirements: When tested in accordance with FM 1-T 027 and FM 1-T 011, the target (mix design) aggregate gradation, including the mineral filler, shall be within the gradation range for a Type II mixture shown in Table 335-4.

Table 335-4 Aggregate Gradation Requirements		
Sieve Size	Type II Mix Design Range Percent Passing	Stockpile Tolerance from Mix Design Percent Passing
3/8 inch	100	N/A
No. 4	90 – 100	± 5%
No. 8	65 – 90	± 5%
No. 16	45 – 70	± 5%
No. 30	30 – 50	± 5%
No. 50	18 – 30	± 4%
No. 100	10 – 21	± 3%
No. 200	5 – 15	± 2%

The aggregate will be accepted from the stockpile located at the project location. The stockpile will be accepted based on five quality control gradation tests conducted in accordance with FM 1-T 002. If the average of the five gradation tests is within the stockpile tolerances shown in Table 335-4 for all of the sieve sizes, then the stockpile is accepted. If the average of the five gradation tests is not within the stockpile tolerances shown in Table 335-4 for any sieve size, remove the stockpiled material and replace it with new aggregate or blend other aggregate sources with the stockpiled material. Aggregates used in blending must meet the quality tests shown in Table 335-3 before blending and must be blended in a manner to produce a consistent gradation. If new aggregate is obtained or blending of aggregates is performed, submit a new mix design to the Engineer for approval prior to production of the mix. The new mix design gradation shall be within the gradation range for a Type II mixture shown in Table 335-4.

The Engineer may obtain stockpile samples at any time. If the average of five gradation tests conducted in accordance with FM 1-T 002 is not within the gradation tolerances shown in Table 335-4 for any sieve size, cease production until the problem is corrected to the satisfaction of the Engineer.

Screen the stockpiled aggregate prior to delivery to the paving machine to remove oversize material and non-desirable particles.

335-2.3 Mineral Filler: If mineral filler is required, utilize non-air entrained Portland cement or hydrated lime that is free from lumps. The Engineer will accept the mineral filler by visual inspection. The type and amount of mineral filler needed shall be determined by a laboratory mix design and will be considered as part of the aggregate gradation. An increase or decrease of less than one percent mineral filler may be permitted during production if it is found to result in better consistency or set times.

335-2.4 Water: Utilize water that is potable and free of harmful soluble salts or reactive chemicals and any other contaminants.

335-2.5 Additives: Additives may be added to the mixture or any of the component materials to provide the control of quick-trafficking properties. The additives to be used should be indicated on the mix design and be compatible with the other components of the mix.

335-3 Mix Design: Before work commences, submit a mix design to the Engineer incorporating the specific materials to be used on the project. The mix design shall be developed by a laboratory which has experience in designing micro-surfacing mixtures.

Submit the proposed mix design with supporting test data indicating compliance with all mix design criteria. Allow the State Materials Engineer a maximum of one week to either conditionally verify or reject the mix as designed. Compatibility of the aggregate, polymer-modified emulsion, mineral filler, and other additives shall be verified on the mix design. Meet the requirements provided in Table 335-5. After the mix design has been approved, no substitutions to the mix design will be permitted, unless approved by the Engineer. The Engineer will consider any marked variations from original test data for a mix design or any evidence of inadequate field performance of a mix design as sufficient evidence that the properties of the mix design have changed, and the Engineer will no longer allow the use of the mix design.

Table 335-5
Mix Design Testing Requirements

ISSA Test No. (1)	Property	Specification Requirements
ISSA TB-139	Wet Cohesion @ 30 Minutes Minimum (Set) @ 60 Minutes (2)	12 kg-cm Minimum 20 kg-cm Minimum or Near Spin
ISSA TB-109	Excess Asphalt by Loaded Wheel Tester (LWT) Sand Adhesion	50 g/sf Maximum
ISSA TB-114	Wet Stripping	90% Minimum
ISSA TB-100	Wet-track Abrasion Loss: One-hour Soak Six-day Soak	 50 g/ft^2 Maximum 75 g/ft^2 Maximum
ISSA TB-147	Lateral Displacement Specific Gravity after 1,000 Cycles of 125 lb.	5% Maximum 2.10 Maximum
ISSA TB-144	Classification Compatibility	11 Grade Points Minimum (AAA, BAA)
ISSA TB-113	Mix Time @ 77°F	Controllable to 120 Seconds Minimum

(1) ISSA = International Slurry Surfacing Association
(2) The mixing test and set-time test should be checked at the highest temperatures expected during construction.

The mix design must clearly show the proportions of aggregate, mineral filler, water, additive usage, and polymer-modified asphalt emulsion based on the dry weight of the aggregate. Meet the mix design component material requirements provided in Table 335-6.

Table 335-6 Mix Design Component Material Requirements	
Component Materials	Specification Requirements
Residual Asphalt	5.5 to 10.5% by dry weight of aggregate
Mineral Filler	0.0 to 3.0% by dry weight of aggregate
Polymer-based Modifier	Minimum of 3% solids based on bitumen weight content
Additives	As needed
Water	As required to produce proper mix consistency

335-4 Rate of Application: The average single application rate, as measured by the Contractor, shall be 20 – 26 lb/sy. Application rates are based upon the weight of dry aggregate in the mixture. The maximum drop off at the edge of the pavement shall be 1/4 in.

335-5 Equipment.

335-5.1 General: Maintain all equipment, tools, and machines, used in the performance of this work, in satisfactory working condition at all times to ensure a high-quality product.

335-5.2 Mixing Equipment: Use a machine specifically designed and manufactured to place micro-surfacing. Truck mounted and self-loading continuous machines are acceptable. Mix the material with an automatic-sequenced, self-propelled micro-surfacing mixing machine, which is a continuous-flow mixing unit able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, control setting additive, and water to a revolving multi-blade, double-shafted mixer and to discharge the mixed product on a continuous-flow basis. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, control additive and water to maintain an adequate supply to the proportioning controls. Self-loading continuous machines shall be capable of loading materials, while continuing to lay microsurfacing, thereby minimizing construction joints. Self-loading continuous machines shall be equipped to allow the operator to have full control of the forward and reverse speeds during applications of the micro-surfacing material and shall be equipped with opposite-side driver stations to assist in alignment. The self-loading device, opposite-side driver stations, and forward and reverse speed controls shall be original equipment manufacturer design.

335-5.3 Proportioning Device: Provide and properly mark individual volume or weight controls for proportioning each material to be added to the mix (i.e., aggregate, mineral filler, emulsified asphalt, additives, and water).

335-5.4 Spreading Equipment: Agitate and spread the mixture uniformly in the surfacing box by means of twin-shafted paddles or spiral augers fixed in the spreader box. Provide a front seal to insure no loss of the mixture at the road contact point. The rear seal shall act as a final strike-off and shall be adjustable. The spreader box and rear strike-off shall be so designed and operated that a uniform consistency is achieved to produce a free flow of material to the rear strike-off. The spreader box shall have suitable means provided to side shift the box to compensate for variations in the pavement geometry.

335-5.4.1 Secondary Strike-off: Provide a secondary strike-off to improve surface texture. The secondary strike-off shall have the same adjustments as the spreader box.

335-5.4.2 Rut-filling Box: Place preliminary micro-surfacing material to fill ruts, utility cuts, depressions in the existing surface, etc., when required on the plans and before the final surface course is placed. Fill in ruts of 1/2 inch or greater in depth independently with a rut-filling spreader box either five or six feet in width. For irregular or shallow rutting of less

than 1/2 inch in depth, place a full-width scratch-coat pass, if so directed by the Engineer. Ruts that are in excess of 1-1/2 inches in depth may require multiple placements with the rut-filling spreader box to restore the cross-section. Cure all rut-filling leveling material under traffic for at least a twenty-four hour period before additional material is placed on top of the leveling material.

335-5.5 Auxiliary Equipment: Provide suitable surface preparation equipment, traffic control equipment, hand tools, and any other support and safety equipment necessary to perform the work.

335-6 Calibration: Calibrate each mixing unit to be used in the performance of the work in the presence of the Engineer prior to the start of construction. Document the individual calibration of each material at various settings, which can be related to the machine metering devices. Do not utilize any mixing unit on the project until the calibration has been completed and approved by the Engineer.

335-7 Weather Limitations: Do not apply micro-surfacing if either the pavement or air temperature is below 45°F. Do not apply m**i**cro-surfacing when there is the possibility that the finished product will freeze within 24 hours. Do not apply micro-surfacing in the rain. The mixture shall not be applied when weather conditions prevent opening to traffic within a reasonable amount of time, as determined by the Engineer.

335-8 Surface Preparation.

335-8.1 General: Immediately prior to applying the micro-surfacing, clear the surface of all loose material, silt spots, vegetation, and other material that will negatively affect the quality of the micro-surfacing utilizing any standard cleaning method. If water is used for cleaning, allow cracks to dry thoroughly before applying micro-surfacing. Protect manholes, valve boxes, drop inlets and other service entrances from the micro-surfacing mixture by a suitable method. The Engineer will approve the surface preparation prior to micro-surfacing. No loose aggregate, either spilled from the lay-down machine or existing on the road, will be permitted.

335-8.2 Cracks: Pre-treat any cracks in the surface of the pavement, with a crack sealer approved by the Engineer, prior to the application of the micro-surfacing. Fill any cracks with a width greater than 1/4 inch. Do not overfill the cracks.

335-9 Application.

335-9.1 General: Pre-wet the surface by fogging ahead of the spreader box. Adjust the rate of application of the fog spray to suit temperatures, surface texture, humidity, and dryness of the pavement.

The micro-surfacing shall be of the desired consistency upon leaving the mixer. Carry a sufficient amount of material in all parts of the spreader at all times so that complete coverage is obtained. Avoid overloading of the spreader. Do not allow lumping, balling or unmixed aggregate in the micro-surfacing mixture.

Do not leave streaks, such as those caused by oversized aggregate, in the finished surface. If excess streaking develops, stop production until the situation has been corrected. Excessive streaking is defined as more than four drag marks greater than 1/2 inch wide and 4 inches long, or 1 inch wide and 3 inches long, in any 30 sy area. Do not permit transverse ripples or longitudinal streaks of 1/4 inch in depth or greater, when measured by placing a 10-foot

straight edge over the surface.

335-9.2 Joints: Prevent excessive buildup, uncovered areas, or unsightly appearance on longitudinal and transverse joints. Provide suitable-width spreading equipment to produce a minimum number of longitudinal joints throughout the project. Place longitudinal joints on lane lines, where possible. Use half passes and odd-width passes only when absolutely necessary. Do not use a half pass as the last pass of any paved area. Do not overlap longitudinal lane line joints by more than three inches. Do not construct joints having more than a 1/4 inch difference in elevation when measured by placing a 10-foot straight edge over the joint and measuring the elevation drop-off.

335-9.3 Mix Stability: Produce a micro-surfacing mixture that possesses sufficient stability so that premature breaking of the material in the spreader box does not occur. The mixture shall be homogeneous during and following mixing and spreading. The mixture shall be free of excess water or emulsion and free of segregation of the emulsion and aggregate fines from the coarser aggregate. Do not spray water directly into the lay-down box while laying micro-surfacing material under any circumstances.

335-9.4 Handwork: Utilize hand squeegees to provide complete and uniform coverage of micro-surface areas, which cannot be reached with the mixing machine. Lightly dampen the area to be handworked prior to mix placement, if necessary. Care shall be exercised to leave no unsightly appearance from handwork. When performing handwork, provide the same type of finish as that applied by the spreader box.

335-9.5 Lines: Construct straight lines along curbs and shoulders. Do not permit runoff on these areas. Keep lines at intersections straight to provide a good appearance. If necessary, utilize a suitable material to mask off the end of streets to provide straight lines. Do not allow edge lines to vary by more than ±2 inches in horizontal variance in any 96 feet of length.

335-9.6 Cleanup: Remove micro-surfacing mixture from all areas, such as manholes, gutters, and intersections, and as otherwise specified by the Engineer. On a daily basis, remove any debris resulting from the performance of the work.

335-10 Quality Acceptance.

335-10.1 Sampling and Testing: The Engineer shall obtain two samples of micro-surfacing mixture for each day of production. The samples shall be obtained at different periods during the production day and the Engineer shall test each sample in accordance with FM 5-563 and FM 1-T 030 to determine the residual asphalt content and the gradation of each sample. Evaporate all water from the sample prior to testing. Determine the deviation of the test results for each sample from the mix design target values. Average the absolute values of the deviations for the two tests. Compare the average deviation from the mix design to the mixture control tolerances shown in Table 335-7.

Table 335-7 Micro-surfacing Mixture Acceptance Limits	
Mix Property	Tolerance from Mix Design Target Values
Percent Passing No. 4 Sieve	± 5 percent
Percent Passing No. 8 Sieve	± 5 percent
Percent Passing No. 50 Sieve	± 4 percent
Percent Passing No. 200 Sieve	± 3.0 percent
Residual asphalt content (based on dry weight of aggregate)	± 0.5 percent

335-10.2 Residual Asphalt Content: If the average deviation of the residual asphalt content for a day's production is greater than the allowable tolerance in Table 335-7, then a two percent reduction in unit price will be assessed for each 0.1 percent the residual asphalt content is outside the allowable tolerance for each day that the tolerance was exceeded. Stop production of the mixture and make adjustments to correct the problem to the satisfaction of the Engineer prior to resuming production.

335-10.3 Aggregate Gradation: If the average deviation of any of the gradation properties for a day's production is greater than the allowable tolerance in Table 335-7, then stop production of the mixture and make adjustments to correct the problem to the satisfaction of the Engineer prior to resuming production.

335-10.4 Aggregate Application Rate: Control the application rate for micro-surfacing to within the range specified in 335-4 on a daily basis. No additional compensation will be paid for micro-surfacing application rates placed in excess of the specified range. The unit price will be reduced by five percent for each lb/sy rate less than the specified range. For application rates outside the specified range, stop production of the mixture and make adjustments to correct the problem to the satisfaction of the Engineer prior to resuming production. Accept a pay reduction for deficient daily production or overlay the deficient area at full plan width and depth at no additional cost to the Department.

335-11 Basis of Payment.

335-11.1 General: The micro-surfacing shall be paid for at the Contract unit price per square yard, completed and accepted. Such price and payment shall be full compensation for performing all work, and shall include the cost of all materials, including the cost of the emulsified asphalt and virgin aggregate.

335-11.2 Payment Items: Payment shall be made under:

Item No. 909-335-1 Micro-surfacing – per square yard

APPENDIX B

Mix Design for Micro-surfacing Project

Florida Highway Products (FHP) ISSA Micro-Surfacing Mix Design

ArrMaz Custom Chemicals, Inc

Corporate Technical Laboratory
4800 SR 60 East
Mulberry, FL 33860

Microsurfacing Contractor:	Florida Highway Products (FHP)
Emulsion Manufacturer:	Florida Highway Products (FHP)
Emulsion Grade:	CSS-1hP
Base Binder:	NuStar PG 67-22 -Savannah, GA
Latex:	UltraPave UP1158, 3.00% polymer solids by weight asphalt
Aggregate:	100% Rinker Granite Screenings - FDOT Source No. TM447

Table 1, FHP CSS-1hP Emulsion Test Data

AASHTO T59-08 Test Standard	ISSA A143 Specification	Results
Residue by Distillation, %*	minimum 62.0	66.16
Oil Distillate, Volume %	none	0.00
Residue Penetration 25°C, 100g, 5sec., dmm	40-90	52
Residue Ductility 25°C, 50 mm/sec., cm	minimum 40	>40
Residue Softening Point, °F	minimum 135	147
Sieve Test, %	maximum 0.1	0.01
Particle Charge	Positive = Cationic	CATIONIC
Storage Stability -24 Hour, %	maximum 1%	0.79
Viscosity, Saybolt Furol at 25°C, SFS	20 - 100	45.5

Table 2, Rinker Granite Screenings Aggregate Test Data

AASHTO Test Standard	ISSA A143 Specification	Results
T 176 Sand Equivalency	minimum 65	76
T 27, T11 Aggregate Gradation	*see following pages for complete aggregate gradation data*	

Table 3, Micro-Surfacing Mix Design

Design Component	ISSA A143 Specification - Based on Dry Weight of Aggregate	Formulation
CSS-1hP Emulsion, %	unspecified	12 ± 0.25
Residual Asphalt, %	5.5 - 10.5	7.94 ±0.16
Mineral Filler (Type 1 Portland Cement), %	0.0 - 3.0	0.6 ± 0.1
Total Water, %	As Required for Proper Consistency	10 ± 2
Control Additive, %	As Required for Proper Mixing Time	0.0
Aggregate- Rinker Granite Screenings, %	100	100.0

Table 4, FHP CSS-1hP Microsurfacing System Performance Test Data

ISSA Technical Bulletin No.	ISSA A143 Specification	Results
TB 113 - Mix Time, seconds**	120 Minimum	150
TB 139 - Laboratory Wet Cohesion, kg-cm**	12 Minimum @ 30 Minutes	23 -Spin
TB 139 - Laboratory Wet Cohesion, kg-cm**	20 Minimum @ 60 Minutes	26 -Solid Spin
TB 114 - Wet Stripping	Pass (90% Minimum)	Pass
TB 109 - Excess Asphalt by Sand Adhesion, g/ft^2	50 Maximum	42.72
TB 100 - Wet Track Abrasion Loss, g/ft^2	50 Maximum @ One-hour Soak	18.2
TB 100 - Wet Track Abrasion Loss, g/ft^2	75 Maximum @ Six-day Soak	28.8
TB 147 -Loaded Wheel, % Displacement***	5% Maximum Lateral	2.64
TB 147 -Loaded Wheel, % Displacement***	10% Maximum Vertical	7.54
TB 147 -Loaded Wheel, Specific Gravity***	2.10 Maximum	1.98
TB 144 -Classification Compatibility^	11 Grade Points Minimum (AAA, BAA)	11 Grade Points - BAA

Note: Ottawa Sand (ASTM C190 Standard Sand) value of cohesion tester = 6.0 kg-cm
Note: Laboratory tesing performed under laboratory conditions at 70°F, 42% relative humidity
*Temperature Maximum held to 138°C
**Outdoor Conditions of 79°F, 83% Relative Humidity, Partly Sunny
***1,000 cycles, 125 lbs load
^Testing performed by subconsultant, Paragon Technical Services- Richland, MS

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AASHTO T11 - Materials Finer Than 75 Microns (#200 sieve) in Mineral Aggregates by Washing
AASHTO T27 - Sieve Analysis of Coarse and Fine Aggregates
AASHTO T176 - Plastic Fines in Graded Aggregates by Use of the Sand Equivalency Test

ISSA Recommended Performance Guidelines for Micro-Surfacing, A143
Section 4.2, Aggregate Quality Tests and Grading

Customer:	FL Highway Products (FHP)	Date Sampled:	12/23/2009
Project ID:	Various	Date Tested:	12/29/2009
Aggregate Type:	Rinker Materials Granite Screenings	Technician:	Quy Trihn
Aggregate Source:	FDOT Source No. **TM447** (Cocoa Beach)		

ArrMaz Custom Chemicals, Inc

AAR AASHTO R18

Weight of Container (g) =	646.6
Weight of Oven Dried Sample & Container BEFORE Wash (g) =	1,611.3
Weight of Oven Dried Sample & Container AFTER Wash (g) =	1,542.4
Oven dried sample before wash (g) =	**964.7**
Oven dried sample after wash (g) =	**895.8**
Percent (%) loss on wash =	**7.1**

Sieve Size	Weight Retained (g)	Percent Retained (%)	Cumulative Percent Retained (%)	Cumulative Percent Passing (%)	Type II Percent Passing Range (%)	Stockpile Tolerance -Mix Design, Percent Passing (%)
3/8 (9.5 mm)	0.0	0.0	0.0	**100.0**	100	NA
#4 (4.75 mm)	5.1	0.5	0.5	**99.5**	90-100	± 5
#8 (2.36 mm)	224.7	23.3	23.8	**76.2**	65-90	± 5
#16 (1.18 mm)	239.5	24.8	48.6	**51.4**	45-70	± 5
#30 (0.600 mm)	159.9	16.6	65.2	**34.8**	30-50	± 5
#50 (0.300 mm)	105.0	10.9	76.1	**23.9**	18-30	± 4
#100 (0.150 mm)	82.2	8.5	84.6	**15.4**	10-21	± 3
#200 (0.075 mm)	62.0	6.4	91.1	**8.9**	5-15	± 2

Does aggregate meet ISSA **Type II** grading requirements? **YES**
Does aggregate meet FDOT **Type II** grading requirements? **YES**

Sand Equivalency (SE)

Cylinder No.	1	2	3
Clay Reading	4.8	4.6	5.0
Sand Reading	3.7	3.5	3.6
SE Value	78	77	72
Mean SE Value		**76**	

Does aggregate meet Sand Equivalency requirements? **YES**
(minimum value of 65 required for **Type II**)

C. Ivann Harnish
Technical Manager -Asphalt Additives
ArrMaz Custom Chemicals, Inc.

Rinker Granitic Slurry Screenings- Macon, GA


Wet Track Abrasion Test, 1 Hour Soak, Average Loss = 18.2g/ft2
AD-HERE FHP 1HR CEMENT #2 8/31/09
TB-100 WET TRACK ABRASION
CCS-1hPM 6-11-12-66.2-1.9%
100% RINKER GRANITE SCREENINGS
MACON,GA
AD-HERE FHP 1HR CEMENT #1 8/31/09
TB-100 WET TRACK ABRASION
CCS-1hPM 6-11-12-66.2-1.9%
100% RINKER GRANITE SCREENINGS
MACON,GA
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Wet Track Abrasion Test, 6 Day Soak, Average Loss = 28.8g/ft2
AD-HERE FHP 6 DAY CEMENT #1 8/31/
TB-100 WET TRACK ABRASION
CCS-1HPM .6-11-12-66.2-1.9%
100% RINKER GRANITE SCREENINGS
MACON,GA
#2 6DAY .6/11/12 FHP
#1 6DAY .6/11/12
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LWT, Average Displacement = 2.64% Lateral, 7.54% Vertical
AD-HERE FHP CEMENT #1 8/24/09
TB-147 LOADED WHEEL
CCS-1hPM .6-11-12-66.2-1.9%
100% RINKER GRANITE SCREENINGS
MACON,GA
AD-HERE FHP CEMENT #2 8/24/09
TB-147 LOADED WHEEL
CCS-1hPM .6-11-12-66.2-1.9%
100% RINKER GRANITE SCREENINGS
MACON,GA
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LWT, Average Displacement = 2.64% Lateral, 7.54% Vertical

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