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Type III Micro Surfacing to Extend the Life of Concrete Pavement on I-70 in Region Four

Experimental Feature No. X(06)02

FINAL REPORT

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Utah Department of Transportation Research Division

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TABLE OF CONTENTS

EXECUTIVE SUMMARY VI
1.0 INTRODUCTION 1
2.0 LITERATURE SEARCH 2
3.0 INSTALLATION 3
4.0 METHODOLOGY 4
5.0 DATA 4
6.0 ANALYSIS 7
7.0 CONCLUSIONS 7
8.0 RECOMMENDATIONS/IMPLEMENTATION 7
APPENDIX A 9
APPENDIX B 10
APPENDIX C 11
APPENDIX D 12
APPENDIX E 22

LIST OF FIGURES

FIGURE 1 LOCATION MAP 1
FIGURE 2 TYPICAL EXAMPLE OF POTHOLES CAUSED BY STRESSES FORMING AT EDGE OF CRACKS..... 2
FIGURE 3 LITERATURE SEARCH RESULTS 3
FIGURE 4 NEWLY APPLIED MICROSURFACE 4
FIGURE 5 CRACKING BEGINNING TO APPEAR AT TRANSVERSE JOINTS 5
FIGURE 6 TRANSVERSE JOINTS HAVE BEEN CRACK SEALED, BUT POTHOLES ARE NOT AS EVIDENT….5
FIGURE 7 LONGITUDINAL CRACKS HAVE APPEARED AND BEEN SEALED. 6
FIGURE 8 CRACKS HAVE BEEN SEALED AND POTHOLES CONTINUE TO APPEAR TO BE FILLED IN 7

EXECUTIVE SUMMARY

In 2005, a concrete section of I-70, between mileposts 9.87 and 10.15 on the eastbound outside lane exhibited severe cracking and potholing. Region Four, Richfield District Operations determined that a temporary fix needed to be applied to this section of roadway in order to extend its life for a few years.

A microsurface treatment was chosen and Intermountain Slurry Seal Inc. was solicited to provide a treatment process for the outside lane along I-70, spanning a total of 1500 LF. They proposed a double application of micro surfacing for the first 880 LF and a single application of micro surfacing for the next 620 LF. The bid price was $2.00 per square foot for a single application, or one coat.

A literature search revealed that Kansas DOT had successfully used a microsurface treatment to improve the ride and extend the life of concrete pavements on I-135 and I-70.

The micro surfacing treatment was applied on October 24, 2005. Traffic was allowed back onto this area within four hours of the application.

Photographs taken between 2006 and 2008 showed that, although cracks had reflected up through the treatment, the potholes remained filled and the cracks were tighter and more manageable.

Overall, in the opinion of Richfield District Operations personnel, this treatment has extended the life of this section of I-70 by filling the potholes and improving the manageability of the cracks.

The Region Four is implementing this treatment into another project and recommends it as an alternative to extending the life of concrete pavements.

1.0 INTRODUCTION

The section of concrete pavement on I-70 in the Richfield District of Region Four between mileposts 9.87 and 10.15 is approximately 25 years old and is at an elevation of over 7000 feet (Figure 1). The 2007 AADT was 5490 with 44% trucks.

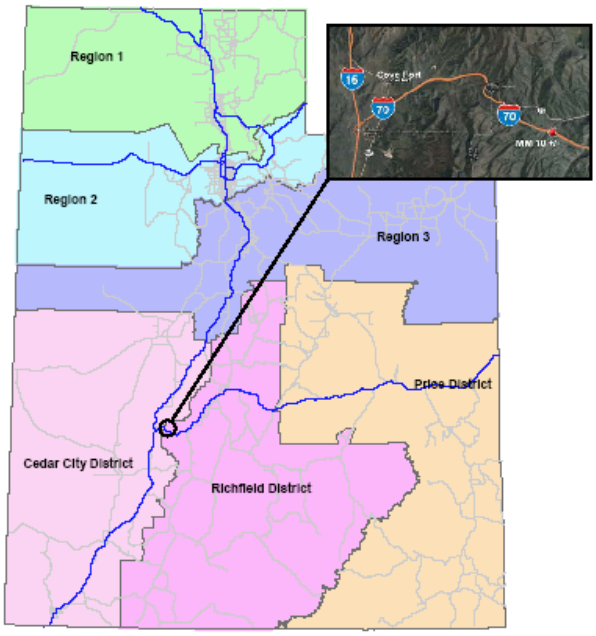

Figure 1 Location map

The original pavement was placed between July 25 and September 10, 1984. Cracking was observed 8 to 10 days after placement. It was estimated that the main causes of the cracking were two-fold: 1) the pavement bonded to the lean base course, and (2) the concrete was subjected to wide temperature variations during the curing process.

Over the years, as the cracks have deteriorated, potholes have formed from the stressed concrete edges. A few years ago Scott Goodwin, Region Four Pavement Engineer; Les Henrie, Richfield District Area Supervisor, and Larry Gay, Region Four Materials Engineer, visited the site to brainstorm possible solutions for the failing pavement. The suggestion was made by Scott, and agreed upon by Les, that a microsurface over the entire outside lane would help fill the potholes and seal the cracks. According to Scott, there were no sophisticated analyses comparing a variety of alternatives based on life cycle costs. (Appendix A)

Microsurfacing is a polymer-modified cold-mix paving system. It is a mixture of dense-graded aggregate, asphalt emulsion, water, and mineral fillers. It is similar to slurry

surfacing but is specialized for situations where very quick trafficking, rut filling or extreme conditions of heat or cold are likely. It is especially effective for sealing cracks, filling ruts or potholes, increasing skid resistance, and extending pavement life with as little as a 3/8 in. thick application. It can be applied at a broad range of temperature and weather conditions with high production rates and minimal traffic delays. More information about microsurfacing can be found at www.micro-surfacing.com.

A photograph showing an example of the general condition of the pavement in 2005, just prior to the placement of the microsurface, is shown in Figure 2.

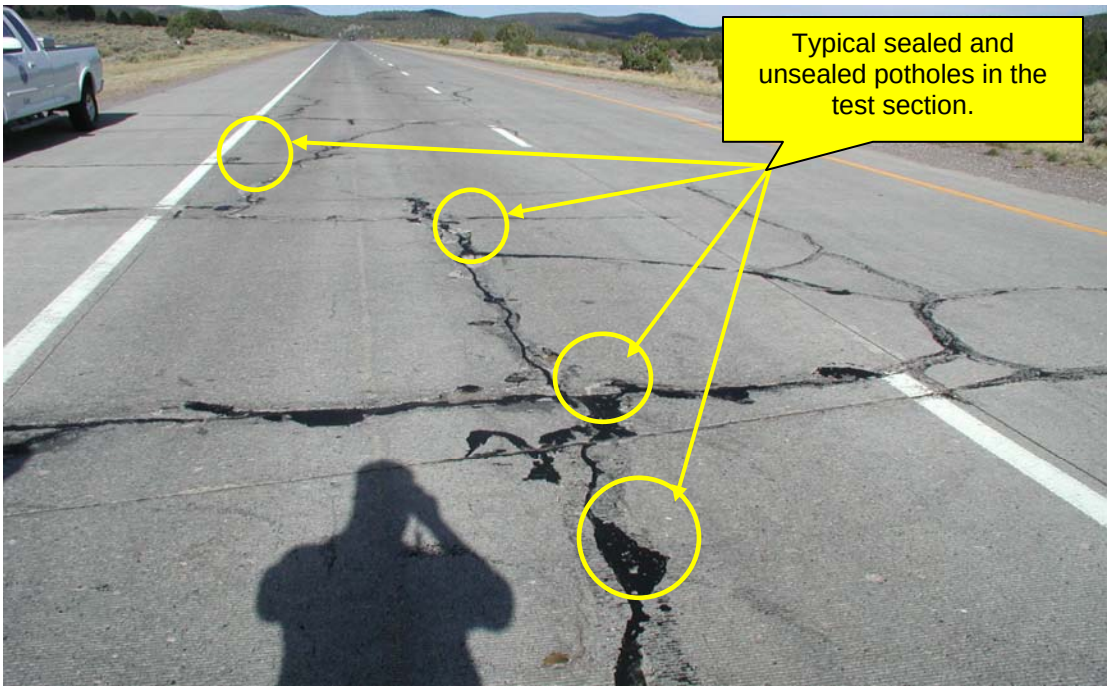

Figure 2 Typical example of potholes caused by stresses forming at edge of cracks. Oct. 2005 (Typical for entire test section)

2.0 LITERATURE SEARCH

The Research Division conducted a literature search to investigate the documented history of a microsurface being used for this particular type of application. The databases searched and the results of the search are shown in Figure 3.

DESCRIPTION	URL	RESULT
AASHTO Product Evaluation Listing (APEL)	http://apel.transportation.org/	No hits
Federal Highway Works Administration	http://www.fhwa.dot.gov/	No hits

(FHWA)		
Research in Progress (RIP)	http://rip.trb.org/	No hits
Texas Transportation Institute (TTI)	http://tti.tamu.edu/	No hits
Transportation Research Information Service (TRIS)	http://ntlsearch.bts.gov/tris/index.do	No hits
State DOT Search Engine	http://www.google.com/coop/cse?cx=006511338351663161139:cnk1qdck0dc	No hits
World Catalogue	www.worldcat.org	No hits
General Google Search	www.google.com	1 hit (see below)

Figure 3 Literature search results

A search on www.google.com revealed an article published by SemMaterials stating that Kansas DOT had applied a microsurface on I-135. According to the article, the applied microsurface improved the riding surface and maintainability of the pavement at a relatively low cost (Appendix B).

Rich Barezinsky, Field Materials Engineer, Kansas Department of Transportation, was contacted to ask his opinion of the article. He stated that he was aware of two applications. An application on I-135 in 1996 was successful in adding 3 to 4 years of life to the pavement before it was reconstructed from 1999 to 2000. Another application on I-70 from the Colorado state line east to Goodland, was also successful in improving the ride for 3 to 4 years. In general, Rick summarized that microsurfacing on distressed concrete pavement has been successful in improving the ride for 3 to 4 years (Apppendix C).

3.0 INSTALLATION

Intermountain Slurry Seal was selected by the Region to apply a Type III microsurface to the pavement section according to UDOT Standard Specification 02735 (Appendix D). The approved mix design was a Ralumac emulsion from SemMaterials LP in North Salt Lake, Utah with a Type III aggregate from the Walker Pit in at the mouth of Big Cottonwood in Holladay, Utah (Appendix E). The bid price was $18.00 per square yard based on a one coat application.

On October 24, 2005 the first lift of micro surfacing was applied at a rate of 50 pounds per square yard for the full 1500 lineal feet. This application was then repeated a second time

for the first 880 lineal feet at a rate of 25 pounds per square yard. Traffic was allowed to return within 4 hours of the application.

4.0 METHODOLOGY

Photographs of the test section, shown in Section 5.0 were taken over time to document the ability of the microsurfacing to seal cracks and fill potholes.

5.0 DATA

5.1 October 2005

Figure 4 Newly applied microsurface, Oct. 2005, (typical for entire test section),

5.2 June 2006

Figure 5 Cracking beginning to appear at transverse joints, June 2006 (typical for entire test section)

5.3 March 2007

Figure 6 Transverse joints have been crack sealed, but potholes are not as evident as before treatment, Mar. 2007 (typical for entire test section)

5.4 August 2008

Figure 7 Longitudinal cracks have appeared and been sealed. Potholes still appear to be filled in, Aug. 2008 (typical for entire test section)

5.5 December 2008

(Site visit with Bret Sorenson, Richfield District Maintenance Engineer and Les Henrie, Richfield District Area Supervisor.)

Figure 8 Cracks have been sealed and potholes continue to appear to be filled in, Dec. 2008 (typical for entire test section)

6.0 ANALYSIS

The data for this study was analyzed in qualitative terms. The photographs from each visual inspection were compared to each other to evaluate the ability of the treatment to seal potholes and improve the manageability of the surface. Based on the photographs, the cracks that have reflected up through the microsurface seem to be tighter and the potholes also have remained filled.

7.0 CONCLUSIONS

According to Scott Goodwin, Region Pavement Engineer, Type III micro surfacing has effectively extended the life of the distressed concrete pavement by five years. "Richfield District feels that the cracks on this test strip are manageable now, whereas before they were becoming what seemed to them unmanageable. Also, the pop outs have been contained. Eventually, the broken pieces of concrete will be worked out by the traffic, but for the last few years they've been kept in place." (Appendix A)

8.0 RECOMMENDATIONS/IMPLEMENTATION

Type III Micro Surfacing has shown to be an effective life extender for concrete pavement with severe pavement distress.

Richfield District's plans for the immediate future are to apply a double layer micro surfacing project on I-70 from MP 7 to 9 in anticipation of extending the pavement life for at least 5 years until funding is available for a rubbleization and overlay treatment.

APPENDIX A

Document received from Scott Goodwin, Region Pavement Engineer, Mar. 5, 2009, responding to a request from the author to summarize the background of the project.

Source: "Investigation of Pavement Cracking Utah I-70, Project ID-70-1(31)7 Clear Creek to Belknap for the Utah Department of Transportation" published by the American Concrete Pavement Association.

According to the above noted source the concrete pavement on this project was placed between July 25 and September 10, 1984. Cracking was observed 8 to 10 days after placement. The primary causes of the cracking were bonding of the pccp to the LCB, as well as the concrete being subjected to temperature differentials of 36 degrees Fahrenheit.

A few years back Les Henrie contacted me and asked if I'd take a ride with him up Clear Creek Canyon. I invited Larry along. Les showed us how the cracks were deteriorating, as stressed concrete sloughed off creating small to medium sized potholes. We used our trip as a brainstorming session and discussed ways to seal cracks and patch holes. I threw out the idea of coating the full surface with microsurfacing as it could do both. I was actually surprised that Les liked the idea.

I contacted Intermountain Slurry. They came down. Les had already picked this location as I recall. It was badly enough cracked that he felt it would be a good test for the product. We discussed with IMS who would provide what and the cost elements to be borne by whom. I heard afterwards that it didn't work out the way it was planned. UDOT ended up paying more than was expected.

There were no sophisticated analyses comparing a variety of alternatives based on life cycle costs. It was pretty much, a "we have a need, let's try this" kind of project. Richfield district feels that the cracks on this test strip are manageable now, whereas before they were becoming what seemed to them unmanageable. Also, the pop outs have been contained. Eventually, the broken pieces of concrete will be worked out by the traffic, but for the last few years they've been kept in place.

Subsequent conversations with Scott:

- Semi-annual road reviews are conducted in the spring and fall
- This project was with Code 1 funds. Not orange or purple book
- Needed to try something else.
- Pavement maintenance decisions are made based on both subjective and quantitative data (DTIMs). But DTIMS is not always complete and doesn't tell the whole story. Localized, immediate decisions must be made
- MP 7-17 (Belknap Interchange) built at the same time in 1985.
- Been on the back burner for years and had been watched. There had not been any faulting, but there had been increased cracking over time which had grown into spalls. Road had been crack sealed over time but no longer sufficient because of increased potholes.
-

APPENDIX B

An article published by SemMaterials available at

http://www.semmaterials.com/maintaining/casestudies/ralumacmicrosurfacing.aspx.

Ralumac® Micro-Surfacing Over PCC - I-135W in Kansas

A Case Study

The problem...
Interstate Highway 135W in south-central Kansas was originally constructed in 1971 and carries an approximate ADT of 4810. The highway is a dowel jointed PCC pavement consisting of 6" lime-treated subgrade, 4" Portland cement treated base, and 9" of Portland Cement Concrete on the surface, with full-depth bituminous shoulders. The Kansas Department of Transportation knew that sections of I-135W were rough and experiencing driveability problems. The highway was also difficult to maintain; previous rehabilitation efforts consisted of PCCP patching in 1990 and 1994. The highway was cracked, spalled, and rough, but structurally sound. The department was looking for a resurfacing alternative that would be safe, economical, efficient, durable, and give a smoother riding surface.

The solution
The contractor on the I-135W resurfacing project proposed the use of Ralumac micro-surfacing as a means of achieving the department's objectives. Ralumac micro-surfacing incorporates carefully selected aggregates and bitumen with special polymers and emulsifiers to create stability, even in multi-stone thicknesses. The Ralumac system is applied using specialized techniques and customized machinery. Mixed on site, Ralumac mix is spread directly onto the paved surface. This particular project was unique, in that the Ralumac material was also used in the trenching and patching operations using a specially designed spreader box.

The process
Ralumac micro-surfacing on this project proceeded quickly because the operators, drivers, and support personnel were well-trained. This particular project used two courses for uniform texture and maximum efficiency with total mixture placed less than 50 pounds per square yard. As a rule, two courses produce superior results in terms of durability, surface texture, driveability, and drainage. With application rates as low as 40 pounds per square yard, Ralumac material can fill ruts up to one and one-half inches deep in just one pass. Rehabilitation of concrete sections on I-135 used an additional length skid to aid the leveling and smoothing process.

The results of the I-135W project were particularly encouraging to the Kansas Department of Transportation. Ralumac micro-surfacing means substantial cost savings over traditional resurfacing alternatives. With in-place costs as low as 5 cents per pound, Ralumac micro-surfacing's benefits stretch over a useful life of 7 years and more. The Ralumac system means minimal material and milling costs up front, and stability, flexibility, and driveability in the long term--even on roads subjected to high temperatures and traffic.

SemMaterials Technology - Solutions for Tough Conditions
This project is just one example of SemMaterials continual exploration of innovative methods for providing safe, fast, durable, and cost-effective pavements to the motorists on our nation's highways. Contact your local SemMaterials representative for more information on this project, and for help in finding the right solution available in your area for getting the best value from your paving funds and reducing the overall costs of your paving projects.

APPENDIX C

Comments from Rick Barezinsky, Kansas DOT, on Kansas' experience with microsurfacing on PCC pavements:

From: Rick Barezinsky <RickBa@ksdot.org>
To: Ken Berg <kenberg@utah.gov>
Date: 4/16/2009 10:55 AM
Subject: RE: This Kansas DOT Project

Ken,
We have placed micro-surfacing on several PCC Pavements. I know of two of them that were placed on the interstate system. On I-135 north of Newton, the micro-surfacing was placed in 1996. The PCCP was a 61.5' doweled joints with very wide and faulted interpanel cracks. The micro-surfacing was placed as an interim measure before the scheduled reconstruction in 1999 and 2000. In 1999, the micro-surfacing held held-to-head traffic while the other lanes were being reconstructed. Overall, KDOT was pleased with its performance.

On I-70 from the CO-KS state line, east to Goodland; the micro-surfacing was placed on I-70. The pavement was a 15' jointed pavement with skewed joints and no dowels. The ride remained improved for the following 4 years.

Summary, micro-surfacing on distressed Interstate PCCP is successful at improving the ride for 3 to 4 years.

Thanks,
Rick

APPENDIX D

02735 Microsurface Standard Specification

SECTION 02735

MICRO-SURFACING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products and procedures for mixing and spreading a properly proportioned mixture of aggregate, mineral filler, additives, polymer-modified asphalt emulsion, and water.

B. Products and procedures for a cured mixture with a homogeneous appearance, a firm surface adhesion, and a skid resistant texture.
   1. Provide a micro-surface mixture that is capable of being spread in variable thickness cross-sections, ruts, scratch courses, and surfaces.

1.2 RELATED SECTIONS

A. Section 02746: Hydrated Lime

1.3 REFERENCES

A. AASHTO M 17: Standard Specification for Mineral Filler for Bituminous Paving Mixtures

B. AASHTO M 208: Standard Specification for Cationic Emulsified Asphalt

C. AASHTO T 11: Materials Finer Than 75 µm (No. 200) Sieve in Mineral Aggregate

D. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

E. AASHTO T 49: Penetration of Bituminous Materials

F. AASHTO T 53: Softening Point of Bitumen

G. AASHTO T 59: Testing Emulsified Asphalts

H. AASHTO T 96: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

I. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

J. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

K. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester

L. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel

M. AASHTO T 316: Viscosity Determination of Asphalt Binder Using Rotational Viscometer

N. ASTM D 6372: Standard Practice for Design, Testing and Construction of Micro-Surfacing

O. ISSA A 143 Guidelines (Current edition)

P. UDOT Minimum Sampling and Testing Requirements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Provide the Engineer with Mix Design 10 days prior to beginning construction.
   1. Meet requirements of this Section, article 2.6.

B. Provide the Engineer with the following for asphalt/polymer emulsion with job-mix design.
   1. Test report: Meet the requirements of this Section, article 2.1.
   2. A sample of asphalt/polymer emulsion with job-mix design.
   3. A certificate of analysis and compliance from the manufacturer for each shipment
   4. Target gradation for combined aggregate and mineral filler.
   5. Verify asphalt/polymer emulsion supplier adheres to UDOT Minimum Sampling and Testing Requirements Section 508 Asphalt Emulsion Quality Management Plan.

C. Provide test reports for mineral aggregate.
   1. Meet the requirements of this Section, article 2.2.

D. Provide verification that Hydrated Lime meets. Refer to Section 02746.

E. Provide a Manufacturer's Certificate of Compliance for Mineral Filler.

F. Provide calibration documentation for each mixing unit that includes an individual calibration for each material at various settings, which can be related to the machines metering devices.

G. To make changes in the job-mix gradation:
   1. Submit a written request for a change in the job-mix gradation.
   2. Submit a new job-mix design if any changes in gradation are outside the gradation band allowed by the stockpile tolerance in Table 2.

PART 2 PRODUCTS

2.1 EMULSIFIED ASPHALT

A. Use a CSS-1h, quick-set polymer-modified asphalt emulsion conforming to AASHTO M 208; delete the cement mixing test requirements.

B. Mill or blend the polymer material into the asphalt or emulsifier solution prior to the emulsification process.

C. The asphalt/polymer emulsion must parallel the standard from an established infrared spectrum characterizing the asphalt/polymer emulsion.

D. Modified Emulsion Residue, meet Table 1:

Table 1

MODIFIED EMULSION RESIDUE		
TEST	**DESCRIPTION**	**SPECIFICATION**
AASHTO T 49	Penetration, 77°	40-90
AASHTO T 53	Softening point	135° Min
AASHTO T 59-modified (a)	F Residue by distillation	62% Min.
AASHTO T 316	Rotational Viscosity 275° F	650 CPS
(a) Modified distillation procedure: Heat emulsion residue to 270 ± 10 degrees F and maintain that temperature for 20 minutes. Perform the distillation within 60 ± 15 minutes		

2.2 MINERAL AGGREGATE

A. Use 100 percent manufactured mineral aggregates that meet the following requirements:
   1. Clean and free from organic matter, clay balls, or other detrimental substances.

2. Maximum weighted sodium sulfate soundness loss of 15 percent. Refer to AASHTO T 104.
3. Maximum loss by abrasion of 30 percent. Refer to AASHTO T 96.
4. Sand equivalent of sixty or greater. Refer to AASHTO T 176.
5. Minimum polishing value of 31. Refer to AASHTO T 278 and T 279.
   a. Performed on aggregate prior to crushing.
   b. Predominantly limestone or dolomite aggregates will not be accepted.

B. Select a job mix or target gradation within the gradation band. Base the mix design on this gradation. The percent passing each sieve will not vary by more than the stockpile tolerance and still remain within the gradation band after the target gradation has been submitted. Refer to AASHTO T 11, AASHTO T 27, and Table 2.

Table 2

Job-Mix Gradation Design Limits		
Sieve Size	Broad Band Gradation Percent Passing	Stockpile Tolerances
⅜	100	0
#4	70-90	±5
#8	45-70	±5
#16	28-50	±5
#30	19-34	±5
#50	12-25	±4
#100	7-18	±3
#200	5-15	±2

2.3 MINERAL FILLER

A. Use portland cement, hydrated lime, or aluminum sulfate as specified in AASHTO M 17

2.4 WATER

A. Use water that is potable and free from harmful salts, reactive chemicals, and any other contaminants.

2.5 ADDITIVES

A. Use additives as required to accelerate or retard the break-set of the micro-surface mix, to improve the resulting finished surface, or to increase adhesion.
   1. Determine the initial additive quantities from the mix design for the micro-surface mix or individual materials.
   2. Use additives that are compatible with the other components of the mix.
   3. Obtain Engineer approval for use of additives.

2.6 JOB-MIX DESIGN

A. Design according to ASTM D 6372-99a.
   1. Show each ingredient amount:
      a) Residual asphalt cement content, within 7.5 ± 2 percent by dry total weight of aggregate.
      b) Aggregate gradation (target) within the job-mix gradation design limits in Table 2.
      c) Mineral filler, percentage by total dry weight of aggregate.
      d) Polymer modifier 2.5 percent minimum polymer solids based on the residual asphalt content.
   2. Identify additives as determined by design testing to control mix set times and adhesion.
      a) Provide acceptable percent limits for additives.
   3. Conform to the ISSA A143 specifications listed in Table 3.
   4. Use the same materials and aggregate gradation to be used on the project.

Table 3

ISSA Specifications		
ISSA TEST NO.	**DESCRIPTION**	**SPECIFICATION**
ISSA TB-139	Wet Cohesion @ 30 Minutes Minimum (Set) @ 60 Minutes Minimum (Traffic)	12 kg-cm Minimum 20 kg-cm Minimum or Near Spin
ISSA TB-109	Excess Asphalt by LWT Sand Abrasion	50 g/ft^2 Maximum (538 g/m^2 Maximum)
ISSA TB-114	Wet Stripping	Pass (90% Minimum)
*ISSA TB-100	Wet-Track Abrasion Loss One-hour Soak Six-day Soak	50 g/ft^2 (538 g/m^2) Maximum 75 g/ft^2 (807 g/m^2) Maximum
ISSA TB-147	Lateral Displacement Specific Gravity after 1,000 Cycles of 125 Pounds	5% Maximum 2.10 Maximum
ISSA TB-144	Classification Compatibility	11 Grade Points Minimum (AAA, BAA)
ISSA TB-113	Mix Time @ 77 degrees F	Controllable to 120 Seconds Minimum

* Perform the wet track abrasion test under laboratory conditions as a component of the mix design process.

2.7 EQUIPMENT

A. Use mixing equipment specifically designed and manufactured to mix and place micro-surfacing.

1. Mix the material by an automatically sequenced, self-propelled micro-surfacing mixing machine that will be 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 discharge the mixed product on a continuous flow basis.
2. Use a machine with sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, control additive, and water to maintain an adequate supply to the proportioning controls.
3. Use a machine capable of self-loading materials while continuing to place micro-surfacing.

4. Equip the machine to allow the operator to have full control of the forward and reverse speed during applications of the micro-surfacing material.
   a) Use original equipment manufacturer design for the self-loading device, opposite side driver stations, and forward and reverse speed controls.
5. Use proportioning devices with individual volume or weight controls for proportioning each material, such as aggregate, mineral filler, emulsified asphalt, additive, and water to be added to the mix.
   a) Use proportioning devices with controls properly marked that calibrate and determine the material output at any time.

B. Use spreading equipment that will agitate and spread the mixture uniformly by means of twin-shafted paddles or spiral augers fixed in the spreader box.
   1. Provide a front seal that results in no loss of mixture at the road contact point.
   2. Provide an adjustable rear seal that acts as final strike-off.
   3. Use a spreader box with the rear strike-off designed and operated to produce a free flow of uniformly consistent materials to the rear strike-off.
   4. Use a spreader box with a suitable means provided to side shift the box to compensate for variations in the pavement geometry.
   5. Provide a secondary strike-off to improve surface texture and with the same adjustments as the spreader box.
   6. Use a rut filling spreader box specifically designed to fill ruts when filling ruts with an average depth greater than one-half inch.
      a) Apply micro-surface as a scratch-coat pass when required to fill ruts less than ½ inch at the direction of the Engineer.
      b) Make multiple passes with the rut filling spreader box for ruts of over ½ inch at the direction of the Engineer.
      c) Allow a 24-hour cure time after filling ruts before placing final micro-surfacing layer.

C. Calibrate each mixing unit in the presence of the Engineer as follows:
   1. Prior to using on the project.
   2. After repairs or as directed by the Engineer.

PART 3 EXECUTION

3.1 LIMITATIONS

A. Do not apply micro-surface during rain, when road surface moisture is present, or during other adverse weather conditions.

B. Do not apply micro-surface if either the pavement or air temperature is below 50 degrees F.

C. Do not apply micro-surface when the temperature is projected below 33 degrees F within 24 hours of placing micro-surface.

D. Cease micro-surface operations when the weather or other conditions prolong opening road surface to traffic beyond two hours.

E. Keep traffic off roadway surface until the micro-surface has cured.

3.2 STOCKPILE

A. Construct individual 500-ton stockpiles of micro-surface aggregates.
   1. Engineer approves stockpiles a minimum of one and a maximum of seven days prior to use.

B. Notify the Engineer a minimum of seven calendar days prior to micro-surface placement in order for the initial stockpiles to be sampled and tested for acceptance.

C. Obtain the Engineer's written acceptance of a stockpile prior to its use in micro-surface.

D. Remove material not meeting specifications from the stockpile area.

E. The Department will retest corrected material for acceptance.

3.3 PREPARATION

A. Clean the surface of all dirt, sand, dust, oil, and other objectionable material immediately prior to applying micro-surface.

B. Allow un-sealed cracks to dry thoroughly prior to applying micro-surface when using water to clean the road surface.

C. Cover manholes, valve boxes, drop inlets, and other service utility entrances prior to surfacing.

3.4 APPLICATION

A. Pre-wetting the surface is allowed when required by local conditions by fogging ahead of the micro-surface box.
   1. Do not over apply causing free water to sit on the pavement in front of the micro-surface box.

B. Place micro-surface mix that meets the job-mix design.
   1. Control the ingredients proportions by metering or measuring devices on the micro-surfacing equipment.
      a. Use readings from the metering or measuring devices to determine compliance with limits stated in the approved job-mix design.
   2. Limit any increase or decrease in the amount of mineral filler added to the mix during production to ±1 percent of the job-mix design.
   3. The emulsion submitted with the job-mix design will serve as the standard to assure the same emulsion is used throughout the project.
      a. Engineer may request a new job-mix design and re-approval of the micro-surfacing if large disparities occur.

C. Pass the mineral aggregate over a scalping screen prior to transfer to the micro-surfacing mixing machine to remove oversize material.

D. Carry a sufficient amount of micro-surface in all parts of the spreader so that full width and complete coverage is obtained with no streaks or narrow spots.
   1. Avoid overloading the spreader.

E. Apply micro-surface of proper consistency at an average rate of 24 to 30 lb/yd^2.
   1. Apply micro-surface for rut filling as required.

F. Do not add additional water for any reason once the mixture has been placed onto the road surface.

G. Remove and replace the micro-surface if any of the following occurs:
   1. Lumping, balling, or unmixed aggregates.
   2. Separation of the coarse aggregate from the emulsion and fines.
   3. Excessive breaking of emulsion inside the spreader box.
   4. Streaking caused by oversized aggregate.
   5. Flushing or excessively rich areas appearing in the micro-surfacing after two hours from the time of placement.
   6. Any measurable rutting, shoving, or other evidence of premature deformation when exposed to traffic with re-approved micro-surfacing materials and procedures.

3.5 TEST STRIP

A. Apply a test strip of at least 500 ft in length on the roadway before initial placement commences.
   1. Achieve initial set within 30 minutes and show no visual signs of distress when exposed to traffic action after curing for 2 hours.

2. Become part of the completed item if the above conditions are present and all other requirements are met.
3. Remove and replace the micro-surfacing at no expense to the Department if the test strip fails to meet the conditions stated above.

B. Make necessary adjustments if test strip does not pass.
1. Obtain approval from the Engineer prior to repeating the test strip process.
2. The Engineer may require a new job-mix design if failures indicate an ingredient problem.

3.6 FINISHING DETAILS

A. Place the micro-surface so the depth of each course does not exceed twice the maximum aggregate size.

B. Do not create build-up when constructing longitudinal and transverse joints.

C. Place micro-surface adjacent to concrete pavements or concrete curb and gutter with a straight longitudinal edge.
1. Do not allow over-lap in these areas.

D. Maintain straight lines at all locations.

E. Place micro-surface at side streets and intersections out to right-of-way line.

F. Use hand squeegees to spread micro-surface in areas that cannot be reached with micro-surface machine.
1. Lightly dampen areas prior to mix placement.
2. Provide complete and uniform coverage.
3. Avoid unsightly appearance from handwork.
4. Use the same type of finish in hand worked areas as applied by the spreader box.

G. Use construction paper or comparable products so all beginning and ending joint lines from each construction pass are straight.

END OF SECTION

APPENDIX E

Microsurface mix design

SemMaterials™

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LABORATORY REPORT

REPORT#:	2005.0111(M)
REPORT DATE:	August 10, 2004
SALESMAN:	Jim Hulse
REPORTED BY:	Susan McFarland
SUBJECT:	Type III Microsurfacing Design Verification Report
CONTRACTOR:	ISS
PROJECT:	UT #IM-15-7(214)332

SUMMARY: A Microsurfacing design verification from existing 2005 data was performed using Ralumac emulsion from SemMaterials LP in North Salt Lake, UT and Type III aggregate from CPC / Walker Pit, Utah.

The emulsion and mix meet project specifications for use in Microsurfacing applications.

The following mix is recommended based on weight percent of the dry aggregate:

Aggregate:	**100%**
Emulsion:	**11-13%**
Total Moisture:	**6-12%**
Cement:	**0 – 1.0%**

Slight modifications of the mix may be necessary in the field due to weather and surface conditions. This must be evaluated by the user at the job site.

The purpose of this report is to confirm the results of our measurement of the properties of the sample tested based upon established testing procedures. (A copy of these procedures is available to you upon request.) Other than our representation that our reported test data represents reliable measurement of the sample tested, we make no other representation or warranties, expressed or implied.

Page 1

Report #2005.0111(M)

Specification 02735S

Test	AASHTO Method	Typical Results	Min.	Max.
A. Emulsion				
Type	Ralumac			
Polymer Content, %		2.5+	2.5	
Viscosity, SFS @77, s	T59	36	20	100
Residue by evap. %	T59	65	62	-
Sieve, wt. %	T59	.02	-	0.10
Residue penetration, 0.1 mm	T49	55	50	80
Softening Point, 77°	T53	143	135	
Kinematic vis, 275°		2680	650	
Ductility @77°F, mm	D 113	50+	40	-
B. Aggregate (data provided by ISS 05/2005)				
Gradation, Type III		pass	pass	-
Sand Equivalent	D 2419	63	55	-
C. Mix Design				
Mixing Time, s	D 3910	200+	180	-
Set Time, min	D 3910	27		
Cohesion values, 77°F	D 3910			
30 minutes		NS – 12		
60 minutes		S - 18		
Wet track abrasion, g loss/ft^2, I-Day	D 3910	11 @ 12% Ralumac	-	75
Boil/ Stripping Test	D 3910	95%	90	
Consistency Test, cm	D 3910	2.5	2	3

The purpose of this report is to confirm the results of our measurement of the properties of the sample tested based upon established testing procedures. (A copy of these procedures is available to you upon request.) Other than our representation that our reported test data represents reliable measurement of the sample tested, we make no other representation or warranties, expressed or implied.

Page 2